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Palæontologia Indica,

BEING

FIGURES AND DESCRIPTIONS OF THE ORGANIC REMAINS PROCURED DURING THE PROGRESS OF THE GEOLOGICAL SURVEY OF INDIA.

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HIMALAYAN FOSSILS.

VOLUME V, MEMOIR NO. 1.

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BY

C. DIENER, PH.D.,
University of Vienna.

INTRODUCTION.

The detailed geological survey of the Khrew and Khunmu areas and between Mandakpal and Narastan in Kashmir by C. S. Middlemiss in 1908 and 1909 has led to the discovery of a Triassic sequence comparable to many of the Central Himalayan sections in Garhwal, Kumaon and Spiti.

The following is a tabular statement of the Triassic horizons, so far detected in this part of Kashmir by C. S. Middlemiss (A revision of the Silurian-Trias sequence in Kashmir, *Records, Geological Survey of India*, XL, Pt. 3, 1910, p. 241) :—

UPPER TRIAS (many thousands of feet thick).	Unfossiliferous, massive limestones. *Spiriferina Stracheyi* and *S. Haueri* zones. Lamellibranch bed.
MUSCHELKALK (ab. 900 feet thick).	*Ptychites* horizon, sandy shales with calcareous layers. *Ceratites* beds do. *Rhynchonella trinodosi* beds do. *Gymnites* and *Ceratites* beds do. Lower nodular limestones and shales. Interbedded thin limestones, shales and sandy limestones.
LOWER TRIAS (ab. 300 feet thick).	*Hungarites* shales (position uncertain). *Meekoceras* limestones and shales. *Ophiceras* limestones.

The large collection of fossils made by C. S. Middlemiss chiefly from the Lower Trias and Muschelkalk was entrusted to me for examination and description by Sir Thomas Holland, then Director of the Geological Survey of India, in 1910. Having been working for the last eighteen years on the Triassic faunæ of the Himalayas, I have taken a special interest in the study of these fossils, the discovery of which fills up a serious gap in our knowledge of the Indian Trias. I wish to express my heartiest thanks to Sir Thomas Holland, to Mr. H. H. Hayden,

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and to Mr. C. S. Middlemiss for offering me the opportunity of examining those interesting materials.

My work has been facilitated by the excellent memoir of C. S. Middlemiss on the Silurian-Trias sequence of Kashmir and by his exact determination of the stratigraphical habitat of each single fossil.

The descriptions in this memoir have been disposed according to the three main divisions of the Trias in Kashmir. As regards the stratigraphical layers of the species described, I follow entirely the nomenclature adopted by C. S. Middlemiss in his memoir quoted above (pp. 241—257).

I.—FOSSILS FROM THE LOWER TRIAS.

Class : CEPHALOPODA.

Sub-class : AMMONOIDEA.

Gen. XENODISCUS Waagen.

It was demonstrated by A. v. Krafft (*Palæontol. Indica*, ser. XV, Himalayan foss., Vol. VI, Pt. 1, p. 85), that the Indian species from the Lower Trias of the Himalayas, which had been described by myself under the generic name of *Danubites* in 1897, cannot be separated from *Xenodiscus* Waagen, the considerable variability in the length of their body-chambers being no reliable systematic basis for their classification.

The genus *Xenodiscus*, if taken in the circumscription proposed by A. v. Krafft in his posthumous work published in 1909, is represented very richly in the Lower Trias of Kashmir. The number of species collected by C. S. Middlemiss amounts to ten, among them four being new. It is of special interest that all the Kashmir species, with one exception, are provided with rounded external parts and that only a single form with indistinct marginal edges has been noticed, whereas in the Ceratite formation of the Salt Range biangular forms play a very important part.

The evident affinities, which exist between *Xenodiscus* and *Ophiceras*, are marked very strongly in the material now under description. The two genera, which agree entirely in their general shape, involution and sutures, can only be grouped together according to the sculpture of their shells. Among my materials there are several specimens, which must be considered as transitional shapes connecting the two genera. One of them has been illustrated in Pl. II, fig. 1. Its outer whorl is perfectly smooth. The penultimate volution is distinguished by the presence of straight, radiating, delicate ribs, occurring only in very small numbers. In the inner volutions the ribs are more numerous, but extremely delicate. The sculpture, although too insignificant to justify a separation of this specimen from *Ophiceras*, agrees on the other hand with the ornamentation of *Xenodiscus*, the ribs being straight, not curved, as in typical species of *Ophiceras*.

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A second specimen, which has been illustrated in Pl. II, fig. 2, agrees exactly with *Ophiceras tibeticum* Griesbach in its involution and transverse section, but in the penultimate whorl broad and coarse ribs are developed, imparting to this whorl the sculpture of the *Ammonea trachyostraca*. This distinctly circumplicate sculpture marks our specimen as a transitional form connecting *Ophiceras* and *Xenodiscus*.

In his memoir on the Trias of Albania (*Beitræge zur Palæontologie u. Geol. Österreich-Ungarns*, etc., XXIV, 1911) G. v. Arthaber has recently proposed a new system of classification of Lower Triassic *Ammonoidea*. In this system he follows Waagen in uniting all genera with adventitious lobes in one phylum: *Beloceratea*. All ammonites without adventitious lobes, and provided with a short body-chamber, are divided into the phyla *Tornoceratea* and *Gephyroceratea*. *Xenodiscus* has been placed in the first phylum, *Ophiceras* with the *Meekoceratidæ* in the second. Now I think that *Ophiceras* is separated so vaguely from *Xenodiscus*, that they cannot reasonably be looked upon as belonging to two different phyla, which were already separated widely in the Devonian period. The rich materials from Kashmir show their close affinity in a most striking manner.

Leaving aside the question as to how far the line of argument followed by G. v. Arthaber is justified, I cannot help thinking that the three phyla of *Beloceratea*, *Tornoceratea* and *Gephyroceratea* in G. v. Arthaber's interpretation are an assemblage of very heterogeneous elements, which do not correspond to any natural groups of Triassic ammonites.

My specimens are too much broken to show the exact length of the body-chamber, but in one example it was seen to be more than three-quarters of the last volution in length.

XENODISCUS HIMALAYANUS Griesbach.

(Pl. II, figs. 3, 4.)

1880. *Ophiceras himalayanum* Griesbach, Palæontological notes on the Lower Trias of the Himalayas, *Records, Geological Survey of India*, XIII, Pt. 2, p. 111, Pl. III, fig. 8.
1897. *Danubites himalayanus* Diener, Himal. foss., *Palæont. Ind.*, ser. XV, Vol. II, Pt. 1, Cephalopoda of the Lower Trias, p. 41, Pl. XIV, fig. 14.
1909. *Xenodiscus himalayanus* Krafft et Diener, *ibidem*, Vol. VI, Pt. 1, Lower Triassic Cephalopoda from Spiti, etc., p. 92, Pl. XIII, fig. 2.

Griesbach founded this species on a single but fairly preserved specimen imbedded in a slab of dark limestone from the Otoceras beds of the Shalshal cliff, side by side with a small example of *Otoceras Woodwardi* Griesb. It was redescribed by me in 1897. A second specimen was discovered by A. v. Krafft among the collections obtained by Mr. LaTouche from the Lower Trias of the ridge opposite Ralphu glacier between the Dharma and Lissar valleys.

The species is rather common in the Lower Trias of Kashmir. Some examples agree with Griesbach's types in all their characters of specific importance.

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The specimen illustrated in fig. 3 belongs to this group of forms, whose identity with *Xenodiscus himalayanus* cannot be doubted. It exhibits the same mode of involution and pattern of sculpture, which have been noticed in the type from the Shalshal cliff. Slight differences might be found in the shape of the cross-section, which, although cordate, shows the largest transverse diameter somewhat above the umbilical margin, and in the smaller number of straight ribs in the chambered portion of the shell. Of such ribs eight have been counted in half a volution, whereas in Griesbach's type the number is ten. But those small differences are certainly not of specific value, my materials showing a wide range of variation, both in the shape of the cross-section and in the number of straight ribs.

On the other hand the agreement with the type-specimen from the Shalshal cliff includes even some characters of detail. The umbilical wall, which is low in the inner volutions, gradually increases in height towards the aperture. The difference in the shape and strength of the ribs in the chambered portion of the shell and in the body-chamber respectively is very conspicuous, but even among the delicate ribs in the apertural region some are stronger than the majority.

Around this form, which approaches most nearly to the type-specimen of *X. himalayanus*, a large number of varieties is grouped, which differ from the type more or less in the shape of the cross-section, and in the number and shape of the ribs. The transverse section is no longer decidedly cordiform, but either lanceolate or irregularly oval. The number of radial ribs in half a volution varies from six to ten. These ribs are in the majority of examples perfectly straight and strongest in the immediate vicinity of the umbilical region, but in one specimen I found them to be bent forward near the siphonal margin even more strongly than in Griesbach's type.

The sculpture of the anterior part of the last volution, which corresponds to the body-chamber, is always markedly different from that prevailing in the chambered portions of the shell. But the stage of growth at which this change of ornamentation sets in varies considerably in different individuals. In the majority of examples it is noticed as soon as a diameter of 35 to 40 mm. has been reached. In some exceptional cases, however, a remarkable retardation in the acquirement of this new sculpture is seen. In the specimen illustrated in fig. 4 the original sculpture persists even until a diameter of 60 mm. has been reached. To such a retardation, however, I cannot attribute any specific importance.

The present materials having convinced me of the wide range of variation peculiar to this species, I am inclined now to include in *X. himalayanus* the specimen from the Otoceras beds of the ridge between the Dharma and Lissar valleys, which has been described as *Danubites sp. ind. ex aff. himalayano* in my memoir on the Cephalopoda of the Lower Trias (*l.c.*, Vol. II, Pt. 1, p. 44, Pl. XIV, fig. 10).

Dimensions.—Diameter of the shell		44 mm.
„ „ umbilicus		18 „
Height	of the last volution	14 „
Thickness	of the last volution	10 „

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Sutures.—The sutural line has been found clearly exposed in a small number of examples only. It often differs from that seen in the type by the absence of a distinct auxiliary saddle. But this difference is, assuredly, not of specific importance in view of the great variability in the development of auxiliary elements in *Ophiceras* and *Meekoceras*.

Locality, number of specimens examined.—Ophiceras bed, Pastannah, hor. **1, 5-9-09, 14.**

Remarks.—Large specimens of *X. himalayanus* exhibit a remarkable similarity with *Meekoceras falcatum* Waagen (Ceratite formation, *Palæont. Indica*, ser. XIII, Salt Range Foss., Vol. II, p. 242, Pl. XXXVI, fig. 4) from the Stachella beds of Amb. The only difference, which, however, is sufficient to separate the two as distinct species, is the considerable amount of involution in *M. falcatum*. Waagen describes the last whorl in his type-specimen as overlapping the penultimate one to the extent of rather more than two-fifths of the entire height of the former. In all my examples of *X. himalayanus* the amount of involution is much smaller. In the two specimens figured one-quarter and one-third of the height of the penultimate whorl only is hidden by the last volution. This corresponds to an overlap of one-seventh and one-fifth part respectively of the height of the last volution.

XENODISCUS cf. LISSARENSIS Diener.

(Pl. I, fig. 11.)

1897. *Danubites lissarensis* Diener, Himalayan foss., *Palæontol. Indica*, ser. XV, Vol. II, Pt. 1, Cephalopoda of the Lower Trias, p. 45, Pl. XIV, figs. 8, 9, 11.
1909. *Xenodiscus lissarensis* Diener et Krafft, *ibidem*, Vol. VI, Pt. 1, Lower Triassic Cephalopods from Spiti, etc., p. 96.

Although this species has been based on imperfect fragments only, it is well characterised by a number of features, which can be restored by a combination of the different fragments. Its most important character is the difference in the ornamentation of the body-chamber and chambered portion of the shell, which is even more distinctly marked than in *X. himalayanus*.

In the Himalayan collection from Kashmir one single specimen exhibits a remarkable similarity to *X. lissarensis*. Its outer volution, as far as preserved, is covered with very numerous, low and delicate, falciform ribs, whereas the inner whorls are adorned with broad, radial folds, which are, however, arranged more closely than in the type. Its umbilicus is comparatively wide and shallow. There is no trace of marginal edges. Umbilical wall very low. Lateral parts running parallel for a considerable distance.

Dimensions.—Diameter of the shell		36 mm.
,, ,, umbilicus		17·5 ,,
Height	of the last volution	9 ,,
Thickness	of the last volution	7 ,,

Sutures.—Not known.

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Locality, number of specimens examined.—Ophiceras layer, Pastannah, hor. **1, 5-9-09, 1.**

Remarks.—A specimen of *Xenodiscus* from the Lower Trias of Lang-son, Tonking, has been compared to *X. lissarensis* by H. Mansuy (*Contribution à la carte géologique de l'Indochine, Paléontologie*, Hanoi-Haiphong, 1908, p. 63, Pl. XVI, fig. 12), but is too badly preserved to permit of specific identification.

Xenodiscus æquicostatus nov. sp.

(Pl. II, fig. 10.)

This species is of particular interest on account of its close resemblance to *Xenodiscus Bittneri* Hyatt et Smith (Triassic Cephalopod genera of America, *U. S. Geol. Surv. Prof. Pap.*, No. 40, p. 123, Pl. XX, figs. 5—15, XXI, figs. 1—13), from the Middle Trias of the Inyo range, California. It is represented in the Himalayan collection by several well preserved specimens, none of which, however, is provided with a complete body-chamber.

The whorls are numerous, increasing very slowly and embracing each other but very little. Umbilicus very shallow. Transverse section roughly oval. Siphonal and umbilical margins rounded. Lateral parts regularly arched, passing gradually into the siphonal part.

Flanks ornamented with numerous, moderately strong ribs, which are falciform and cross the siphonal part in adolescent stages of growth. In old age they become obsolete near the siphonal margin. In the inner volutions the ribs are broader and more irregular than in the penultimate and last whorl. The ribs are occasionally unequidistant, but in general the sculpture is comparatively regular and there is no prominent contrast between the body-chamber and the chambered portions of the shell.

The type-specimen illustrated is completely chambered, notwithstanding its comparatively large size. There are some specimens before me with their body-chambers preserved. In the body-chamber the ornamentation becomes gradually obsolete, but does not change its general character, as in *X. himalayanus*.

Dimensions.—Diameter of the shell	54	mm.
„ „ umbilicus	24	„
Height } of the last volution	17·5	„
Thickness } of the last volution	12	„

Sutures.—Ceratitic. Siphonal lobe shorter than the principal lateral, divided by a median prominence into two narrow branches, which are slightly serrated. Second lateral lobe considerably smaller and shorter than the principal one. The two lateral saddles are much wider than the second lateral lobe. Auxiliary lobe coinciding with the umbilical slope of the flanks.

Locality, number of specimens examined.—Ophiceras layer, Pastannah, hor. **1, 5-9-09, 7.**

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Remarks.—The present species is very nearly allied to *X. Bittneri* Hyatt et Smith. In adult specimens of the American form the ribs are less distinctly falciform, running nearly straight up the flanks from the umbilical suture. In adolescent stages the ribs are accompanied by frequent constrictions, which have not been noticed in the Himalayan shell.

A second species closely allied to the present one is *Dinarites evolutus* Waagen (Fossils from the Ceratite formation, Salt Range Foss., *Palæontol. Ind.*, ser. XIII, Vol. II, p. 32, Pl. X, fig. 3) from the topmost bed of the Ceratite sandstone. Waagen's determination of his type-specimen as *Dinarites* is by no means reliable. It has been based on a distant similarity of the Salt Range species with a group of Ammonites included in the group of *Dinarites cuccensis* by E. v. Mojsisovics, but the systematic position of those Alpine Ammonites themselves is very uncertain, as they are quite dissimilar to the typical forms of *Dinarites*.

Dinarites evolutus Waagen, whose sutures are unknown, should probably be placed in the genus *Xenodiscus*. The sculpture of its last volution agrees almost entirely with that of *X. æquicostatus*, but the inner whorls are nearly smooth and the number of coils within the umbilicus is still larger. A specific identity of the two species is therefore very doubtful and could only be proved with better materials of *D. evolutus* at hand for comparison.

XENODISCUS SALOMONII nov. sp.

(Pl. II, fig. 5.)

This species is distinguished by its strongly compressed shape and by its delicate and irregular ornamentation. In its involution it agrees with *Xenodiscus æquicostatus*, but its whorls are more slender. In the last volution of my largest example a height of 21 mm. corresponds to a width of 12·5 mm. Transverse section regularly oval, without any trace of umbilical or marginal shoulders.

The most remarkable feature of this species is its sculpture. The inner volutions are provided with faint and low ribs, standing at wide, somewhat irregular intervals. At the beginning of the last volution the ribs become more numerous, stronger and acute. The distances between them are very irregular, a weaker rib being occasionally intercalated between two stronger ones. But even the strongest ribs are comparatively low and do not reach the height of the corresponding elements of sculpture in the preceding species. The ribs originate at a short distance from the umbilical suture, are directed radially across the flanks and turned forward in the vicinity of the siphonal margin, but become obsolete before reaching it.

My type-specimen consists of air-chambers only. In a second fragmentary example of larger size the sculpture of the body-chamber is yet more irregular

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and in the meantime more delicate. Some of the ribs in the body-chamber assume a falciform direction and are united into fasciculi, as in *Ophiceras*.

Dimensions.—Diameter of the shell		56 mm.
,, ,, umbilicus		29 ,,
Height	of the last volution	17 ,,
Thickness	of the last volution	11 ,,

Locality, number of specimens examined.—Ophiceras layer, Pastannah, hor. **1**, 5-9-09, **3**.

Xenodiscus Althothæ nov. sp.

(Pl. II, figs. **6**, **11**.)

This species agrees with *Xenodiscus ellipticus* Diener (Himalayan foss., *Palæontol. Ind.*, ser. XV, Vol. II, Pt. **1**, Cephalopoda of the Lower Trias, p. **32**, Pl. XIV, figs. **12**, **13**) in its obliquely elliptical outlines. The elliptical shape is certainly due to an originally elliptical growth, not to crushing in the rocks. Not only do the few examples, by which this species is represented in the Ophiceras layer of Pastannah, occur together with many other individuals of *Ophiceras* and *Xenodiscus*, which have not been deformed in any way, but they are distinguished by a very remarkable sculpture, which has not been found in any specimen of *Xenodiscus* of normal shape.

My type-specimen shows numerous, evolute whorls within the umbilicus. The whorls are bulky and comparatively thick. Transverse section oval, without any umbilical or siphonal margin distinctly defined.

A second very characteristic feature is to be recognised in the change of sculpture taking place in the last whorl of full-grown specimens. In the penultimate whorl of the specimen illustrated in fig. **11** a comparatively small number of high and sharp ribs are noticed, which reach their maximum strength in the vicinity of the rounded siphonal margin. Towards the anterior termination of the last whorl those ribs become more frequent and show a tendency to curve forwards as they cross the siphonal area. In the last volution of my type-specimen illustrated in fig. **6**, which corresponds to the body-chamber, the number of ribs is nearly twice as large as in the preceding volution. The ribs are more delicate, turned forward in the marginal region, and cross the siphonal part, without being interrupted.

In the sculpture of its body-chamber our species reminds us very strongly of *Peripleurocyclus Smithianus* Diener (Himalayan foss., *Palæontol. Indica*, ser. XV, Vol. V, Pt. **2**, Fauna of the Himalayan Muschelkalk, p. 69, Pl. IX, figs. **2**, **3**) from the Muschelkalk of Jolinka, Byans, although in *Xenodiscus Althothæ* the ribs do not reach their greatest elevation in crossing the siphonal area, but in the upper portion of the flanks. A remarkable difference between the two species consists, however, in the absence of siphonal ribs in young individuals of *X. Althothæ*. Thus their ontogeny is entirely different. In *Peripleurocyclus* the

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siphonal ribs are the original character, which persists in old age. In *X. Althothæ* they are a newly acquired feature, which has not yet been noticed in young and adolescent stages of growth.

There is a great variability in the sculpture of the body-chamber in different examples. It is never quite regular, the breadth of intercostal intervals varying to a considerable extent. In one fragment the ribs remain nearly straight throughout their entire length and cross the siphonal part without being distinctly curved forward.

Dimensions.—Diameter of the shell	79	mm.
„ „ umbilicus	34	„
Height of the last volution	25	„
Thickness of the last volution	19	„
Diameter of the shell (at the place of its greatest applanation.)	53	„
„ „ umbilicus (at the place of its greatest applanation.)	23	„
Height of the last volution (at the place of its greatest applanation.)	17·5	„
Thickness of the last volution (at the place of its greatest applanation.)	17·5	„

Locality, number of specimens examined.—Ophiceras layer, Pastannah, hor. 1, 5-9-09, 6.

XENODISCUS cf. ELLIPTICUS Diener.

(Pl. III, fig. 1.)

1897. *Danubites ellipticus* Diener, Himalayan foss., *Palæontol. Indica*, ser. XV, Vol. II, Pt. 1, Cephalopoda of the Lower Trias, p. 32, Pl. XIV, figs. 12, 13.
1909. *Xenodiscus ellipticus* Krafft et Diener, *ibidem*, Vol. VI, Pt. 1, Lower Triassic Cephalopoda from Spiti, p. 97.

This species was founded on two specimens from the Lower Trias of Kuling. The inner volutions of a large example from Pastannah agree exactly with those types, making an exception only of the smaller number of radiating ribs. But in this character the two type-specimens themselves differ considerably. In the last whorl of the smaller one 21 ribs may be counted, whereas in the larger their number increases to 28. In the penultimate whorl of my specimen from Kashmir it is 18. This difference is, therefore, barely of specific importance.

In the last volution of the present example the ribs are lower, sharper and more numerous. They are turned forward slightly in the marginal region before dying out. Only the anterior half of this last volution has been preserved. A little more than the last quarter belongs to the body-chamber. The change in the ornamentation consequently appears to take place, before the body-chamber has been reached.

My specimen has obliquely elliptical outlines and very slowly increasing whorls. The thickness of the last volution increases more rapidly than its height in proportion to the respective measurements of the penultimate whorl. The siphonal part is accessible to observation, as soon as a height of 7 mm. corresponding to a diameter of 20 mm. has been reached at the beginning of the penultimate whorl. It is highly and regularly rounded and does not show any

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trace of flattening or of marginal edges. This observation is inconsistent with A. v. Krafft's opinion, that *X. ellipticus* is only an elliptical variety of *X. radians* Waagen. A second point of difference might be found in the absence of any spiral grooves in the body-chamber whorl of the present specimens.

As a remarkable character of *X. radians* Waag. and *X. rotula* Waag. the presence of a shallow, spiral groove, " running along the middle of the sides of the body-chamber and bearing a few indistinct concentric striæ " is mentioned by A. v. Krafft. " It begins as soon as the lateral sculpture becomes more delicate, and occasionally, therefore, occurs on the chambered portion of the last whorl in *X. rotula* as well as on the body-chamber. It is never equally well seen on both sides, but is clearly developed on one side of almost every well preserved specimen." No trace of this spiral groove has been noticed in the present example, which may therefore be supposed to be an independent species and not identical with *X. radians* Waag.

Dimensions.—Diameter of the shell		72 mm.
,, ,, umbilicus		33·5 ,,
Height of the last volution		22 ,,
Thickness of the last volution		17·5 ,,
Diameter of the shell	at the place of its greatest applanation.	ab. 56 ,,
,, ,, umbilicus	at the place of its greatest applanation.	26 ,,
Height of the last volution	at the place of its greatest applanation.	18 ,,
Thickness of the last volution	at the place of its greatest applanation.	14 ,,
Height at the commencement of the last whorl		14 ,,
Thickness at the commencement of the last whorl		9 ,,

Sutures.—Agreeing with those in *X. radians* and *X. rotula*. Ceratitic development of the lobes very prominent.

Locality, number of specimens examined.—Ophiceras layer, Pastannah, hor. 1, 5-9-09, 1

Xenodiscus Comptoni nov. sp.

(Pl. II, fig. 7.)

This interesting species is distinguished by its very narrow and sharply rounded siphonal part, and by a change in the ornamentation of its body-chamber, which is just the reverse of that which has been noticed in *Xenodiscus himalayanus*, *X. lissarensis*, *X. radians* or *X. ellipticus*. In all those species the ribs become much more delicate and more numerous towards the anterior termination of the body-chamber volution. In the present species they are very numerous and of moderate strength in the inner whorls and in the posterior portion of the last volution. They do not rise exactly in the umbilical suture, but a little above the latter and are distinctly falciform, being strongly turned forward in the marginal region. Although they are strongest near the middle portion of the lateral parts, they do not die out towards the siphonal part, but cross the latter without being interrupted, thus imitating the sculpture, which has been noticed in the

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body-chamber volution of *X. Althothæ*. They are approximately equidistant and of equal strength.

The system of sculpture in the body-chamber differs considerably from that prevailing in the posterior part of the last volution. It consists of few ribs, which are standing widely apart and are much stronger and acute. They do not cross the siphonal part, but become obsolete before reaching its crest.

My type-specimen has slightly elliptical outlines. Its transverse section is lanceolate, the siphonal part being bordered by converging flanks and narrowly rounded, but not acute.

Dimensions.—Diameter of the shell	42·5	mm.
„ „ umbilicus	17	„
Height } of the last volution	15	„
Thickness } of the last volution	10	„

Sutures.—Not known in detail.

Locality, number of specimens examined.—Ophiceras layer, Pastannah, hor. **1**, 5-9-09, 1.

Remarks.—There is a small number of examples from the same locality and horizon, which agree with the type in the presence of a narrowly rounded siphonal part in the change of ornamentation near the commencement of the body-chamber, but differ from it by the small number and radial direction of the ribs in the chambered portion of the shell. They are not identical with the present species, although nearly allied to it, but their indifferent state of preservation does not allow their identification to be carried out with sufficient certainty. I consequently prefer to abstain from a new specific denomination and to mark them provisionally as *Xenodiscus sp. aff. Comptoni.*

XENODISCUS cf. ROTULA Waagen.

(Pl. III, fig. 2.)

1895. *Gyronites rotula* Waagen, Salt Range Foss., *Palæontol. Indica*, ser. XIII, Vol. II, Ceratite formation, p. 300, Pl. XXXVIII, figs. 3—5.
1909. *Xenodiscus rotula* Krafft et Diener, Himalayan Foss., *ibidem*, ser. XV, Vol. VI, Pt. 1, Lower Triassic Cephalopoda from Spiti, p. 93, Pl. XXIII, figs. 4, 5, XXVII, figs. 4, 5.

In the Himalayan collection there is one specimen of *Xenodiscus*, which is probably identical with *X. rotula* Waagen from the Ceratite sandstone of the Salt Range. It is the only specimen of *Xenodiscus* in the collection with a flattened siphonal part and with distinctly defined although obtusely rounded marginal edges. The ribs are less numerous than in equally sized examples of *X. radians* Waag., inequidistant, sharp and very slightly falciform. They are marked most strongly below the middle of the lateral parts. Thus in its ornamentation our specimen agrees very closely with the type of *X. rotula.*

The shallow spiral groove running along the middle of the sides of the body-chamber, which has been noticed in the Himalayan examples of *X. radians* and

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X. rotula by A. v. Krafft, is not seen in our specimen. But as this specimen is incomplete and probably not provided with its body-chamber, the absence of this character is scarcely of any specific importance.

The specimen which agrees most closely with the present example is *X. rotula* from Ensa, illustrated in Pl. XXVII, fig. 4, of A. v. Krafft's memoir.

Dimensions.—Diameter of the shell		28 mm.
„ „ umbilicus		11 „
Height	of the last volution	9 „
Thickness	of the last volution	7 „

Sutures.—Not known.

Locality, number of specimens examined.—Ophiceras layer, Pastannah, hor. **1, 5-9-09, 1.**

Remarks.—The presence of *Xenodiscus rotula* in the Ophiceras beds of Pastannah would be of considerable stratigraphical importance, as this species keeps a distinct layer in the Ceratite formation of the Salt Range, namely, the horizon of the Ceratite marls, in which the Stachella beds occur, according to Koken (*Neues Jahrb. f. Min.*, 1911, I, p. 484). Unfortunately the identification could not be carried out with sufficient certainty.

In the Lower Trias of Spiti the presence of *X. rotula* has been established with certainty by A. v. Krafft, but there its exact stratigraphical horizon is, unfortunately, not known to us.

More recently both *X. radians* and *X. rotula* have been quoted from the Lower Triassic rocks in the Djulfa section by A. Stoyanoff (On the character of the boundary of Palæozoic and Mesozoic near Djulfa, *Abhandl. Mineral. Ges. St. Petersburg*, XLVII, 1910, p. 86, Pl. IX, fig. 5), but the illustrations given by this author did not convince me of the correctness of his determination.

Xenodiscus cf. ophioneus Waagen.

(Pl. II, figs. 8, 9.)

1895. *Lecanites ophioneus* Waagen, *Palæontol. Ind.*, ser. XIII, Salt Range Foss., Vol. II, Ceratite Formation, p. 282, Pl. XXXVIII, fig. 12.

Several species belonging to *Xenodiscus* have been described by Waagen under the generic name of *Lecanites*. *Lecanites ophioneus* W., *L. undatus* W., *L. laqueus* W. have the shape and ornamentation of *Xenodiscus*, from which Waagen separated them only on account of their sutures, which he supposed to be goniatitic. As was remarked by A. v. Krafft (Himalayan foss., *l.c.*, Vol. VI, Pt. I, p. 88), the preservation of Waagen's type-specimens is by no means satisfactory. If we take into consideration how easily the faint denticulations of the lobes are destroyed by weathering, it appears very probable that those types actually belong to the genus *Xenodiscus*. They have certainly nothing to do with the true *Lecanites* Mojs. of Carnic age, which contains only a dwarf-species with reduced goniatitic sutures.

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My Himalayan specimens agree almost perfectly with Waagen's type of *Xenodiscus ophioneus* from the Ceratite formation of Chidru. It needs only a comparison of the illustrations to be convinced of their extreme similarity. The whorls, perhaps, increase still more slowly than in the type from Chidru, but the proportions of the diameter of the shell and the umbilicus on one hand and of the height and thickness of the volutions on the other are exactly the same in the two forms. Transverse section oval, with lateral parts regularly arched, and without any umbilical or marginal edge. Siphonal area evenly rounded and passing gradually into the sides.

The sculpture consists of numerous radiating ribs, which are comparatively broad and distinctly developed in the inner volutions but become more faint and irregular in the last whorl. On the body-chamber of some individuals the ornamentation gradually disappears completely. The ribs are most strongly developed in the middle zone of the sides but do not extend as far as the siphonal part. They are perfectly straight in the adolescent stage of growth, as is seen from the small specimen illustrated in fig. 9, but take a slightly falciform direction on the body-chamber of several full-grown examples.

This is one of the species of *Xenodiscus*, which by the faint development of its sculpture approximates to *Ophiceras*.

Dimensions.—Diameter of the shell		48 mm.
„ „ umbilicus		20 „
Height of the last volution	above the umbilical suture	15 „
	„ „ preceding whorl	11·5 „
Thickness of the last volution		10 „

Sutures.—Ceratitic, agreeing with those of *X. ophioneus* Waagen, in the disposition of the two lateral saddles, the second one being of extremely small size. Siphonal and principal lateral saddles of nearly equal height and width, with their tops broadly rounded. Siphonal lobe broad and shorter than the principal lateral lobe. Its two branches provided with denticulations.

On parts of the cast, where this sutural line has been exposed to weathering, it agrees exactly with that described by Waagen in his type-specimen of *X. ophioneus* from Chidru.

Locality, number of specimens examined.—Ophiceras layer, Pastannah, hor. 1, 5-9-09, 10.

Remarks.—The very close resemblance between my Himalayan specimens and *X. ophioneus* Waag. makes it almost certain that the two species are identical, notwithstanding the apparently goniatitic development of the sutures in Waagen's type. But as the material from the Salt Range is limited to one weathered cast, I must abstain from a direct identification.

Waagen himself considered *Lecanites ophioneus* to be very closely allied to *Ceratites multiplicatus* v. Mojsisovics (Arktische Triasfaunen, *Mém. Acad. Imp. des sciences, St. Pétersbourg*, 7 sér., Vol. XXXIII, No. 6, p. 25, Pl. IX, fig. 15) from the Olenek beds of Siberia. A. v. Krafft (*l.c.*, p. 86) united this species

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with *Xenodiscus* on the strength of the agreement of the group of *Ceratites obsoleti* with *Xenodiscus* in all their important characters.

X. multiplicatus is certainly not identical with *X. ophioneus*, although its shape and sculpture are not unlike that of the Indian species. It has thicker whorls and more irregular ribs. Some of them are even dichotomous and swelling into knob-shaped elevations in the umbilical region. In the body-chamber the ribs become more distant and there is no trace whatever of the ornamentation, which gradually becomes more obsolete than in *X. ophioneus*.

Xenodiscus cf. Sitala Diener.

(Pl. III, fig. 3.)

1897. *Danubites Sitala* Diener, Himalayan foss., *Palæontol. Ind.*, ser. XV, Vol. II, Pt. 1, Cephalopoda of the Lower Trias, p. 49, Pl. XV, figs. 12, 13.
1909. *Xenodiscus Sitala* v. Krafft, *ibidem*, Vol. VI, Pt. 1, Lower Triassic Cephalopoda from Spiti, p. 97.

The most remarkable feature of this species consists in the very large number of delicate folds occurring in the last volution, in sharp contrast with the strong and distant transverse ribs of the inner whorls.

An incomplete specimen from Pastannah agrees fairly well with my type-specimens from the Lower Trias of the Lissar valley, as far as a close comparison is possible between examples so fragmentary and weather-worn as those under examination.

A. v. Krafft compared *X. Sitala* with *X. radians* Waagen. This comparison is correct so far as the ornamentation is concerned, although in none of the Himalayan examples of *X. radians* is the change of sculpture in the last volution as sharp as in *X. Sitala*, but there is undoubtedly a considerable difference between the two species in the transverse section. *X. Sitala* has an oval-shaped cross-section, with a comparatively large transverse diameter and with umbilical and siphonal margins completely rounded off. In *X. radians* the cross-section is more slender and the flattened external part is bordered by obtuse marginal edges.

Dimensions.—Diameter of the shell		ab. 38 mm.
„ „ umbilicus		17·5 „
Height	of the last volution	11·5 „
Thickness	of the last volution	9·5 „

Locality, number of specimens examined.—Ophiceras layer, Pastannah, hor. 1, 5-9-09, 1.

Gen. Ophiceras Griesb.

The genus *Ophiceras*, which may be considered as the leading fossil of the Otoceras beds in Painkhanda, is also very common in the Lower Trias of Kashmir, although in number it does not much surpass the nearly allied genus *Xenodiscus*

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Waag. There is not a single new species among the materials entrusted to me for examination. All of them are either identical with or very nearly allied to such forms, as have been described in my memoir on the Lower Trias of the Himalayas (Vol. II, Pt. 1).

OPHICERAS SAKUNTALA Diener.

(Pl. I, figs. 1, 2.)

1897. *Ophiceras Sakuntala* Diener, Himalayan foss., *Palæontol. Indica*, ser. XV, Vol. II, Pt. 1, Cephalopoda of the Lower Trias, p. 114, Pl. X, figs. 1—8, XI, figs. 1, 2, 4.
1895. *Ophiceras cf. Sakuntala* Diener, Triadische Cephalopodenfaunen der ostsibirischen Kuestenprovinz, *Mém. Com. géol. St. Pétersbourg*, T. XIV, No. 3, p. 45, Pl. II, figs. 5, 7.
1909. *O. Sakuntala* Krafft et Diener, Himalayan foss., *l.c.*, Vol. VI, Pt. I, Lower Trias Cephalopoda from Spiti, p. 81.

This typical form of this species is very rare in Kashmir. Among a large number of specimens, which I have been able to examine, one single example only (Pl. I, fig. 1) might safely be attributed to it. Even this is a little more evolute than the type from the Shalshal cliff, but its umbilicus is just a little smaller than the height of the last volution. Its cross-section is distinctly lanceolate, not oval, its greatest diameter being situated a little above the umbilical margin which is well defined. The lateral parts converge slowly towards the siphonal area, which is highly rounded. In the shape of the latter my specimen differs considerably from *O. Sakuntala var. evoluta*, which has been illustrated by Noetling and Frech in *Lethæa palæozoica* (Vol. II, Dyas, p. 634*f*, fig. 1). The inner whorls are quite smooth. It is only in the last volution, corresponding to a diameter of 30 mm., that delicate, falciform folds are noticed.

All the rest of the specimens, although differing from the typical form, fall within the range of variation of the group of *O. Sakuntala*, as defined in my memoir on the Cephalopoda of the Himalayan Lower Trias.

A variety, which has been met with rather frequently, is distinguished by its oval cross-section and by the absence of any umbilical margin or wall. In such examples the lateral parts slope in an approximately regular curve from the siphonal parts to the umbilical suture. This variety is also common in the Otoceras layer of the Shalshal cliff. It agrees with the typical form in the relation between the height of the last volution and the diameter of the umbilicus, and in the amount of involution. The illustration in the *Lethæa palæozoica*, fig. 2*b*, does not represent a cross-section of the typical form of *O. Sakuntala*, as was suggested by Frech. In the typical form the whorls overlap one another to one-half or at least one-third of their entire height. A smaller amount of involution, as indicated in Frech's illustration, is noticed in *O. demissum* Oppel, not in *O. Sakuntala*.

The lanceolate shape of the transverse section, a character of the typical form of *O. Sakuntala*, is only found occasionally in the specimens from Kashmir, as has been stated by Middlemiss. In the majority of examples the cross-section

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is nearly oval. In some variations the largest transverse diameter is even shifted from the umbilical region to the marginal portion of the lateral parts.

As has been stated by C. S. Middlemiss (*Records, Geol. Surv. of India*, Vol. XL, Pt. 3, p. 242), the representatives of *O. Sakuntala* in Kashmir are connected with *O. ptychodes* by transitional forms. On the other hand there are also transitional forms between those two species and *O. demissum* Oppel. Some examples even exhibit characteristics, which seem to connect the three species. One of them (Pl. II, fig. 2) shows a very small amount of involution—less than one-third of the height of the penultimate whorl—an oval cross-section, with a comparatively large transverse diameter, corresponding exactly with the middle of the height, smooth inner whorls, and, in the third quarter of the last volution, three falciform folds, which are strongly developed and elevated in the umbilical region, but do not cross the siphonal part, as in the typical form of *O. Sakuntala*.

Sutures.—There are few examples, in which the suture line is accessible for examination. It agrees with that of some of the specimens from the Shalshal cliff.

Locality, number of specimens examined.—Ophiceras layer, Pastannah, hor. **1,** 5-9-09, 28.

Ophiceras ptychodes Dien.

(Pl. I, fig. 6.)

1897. *Ophiceras ptychodes* Diener, *Palæontol. Ind.*, ser. XV, Himalayan foss., Vol. II, Pt. 1, Cephalopoda of the Lower Trias, p. 120, Pl. XI, figs. 3, 5, 6.

The majority of specimens in the collection from Kashmir are transitional forms connecting *Ophiceras Sakuntala* Dien. and *O. ptychodes*. But there are some examples, in which the elegant sculpture is scarcely less conspicuous than in the types from the Shalshal cliff. The falciform folds are developed very distinctly and are even seen along the periphery crossing the siphonal part. The specimen illustrated is a good representative of this typical form. This specimen agrees exactly with the types of *O. ptychodes* from the Shalshal cliff in its involution, the diameter of the umbilicus being considerably inferior to the height of the last whorl, and has the umbilical margin distinctly defined. The cross-section is roughly oval, not lanceolate.

Several specimens from Pastannah approach the *var. evoluta* of *O. Sakuntala* and have no distinct umbilical margin.

As a rule the sculpture, although developed in sufficient strength, to distinguish our examples from the typical shapes of *O. Sakuntala*, does not cross the siphonal part. In this character they agree with the form from the Shalshal cliff, illustrated in fig. 6 of my memoir quoted above.

Locality, number of specimens examined.—Ophiceras layer, Pastannah, hor. **1,** 5-9-09, 9.

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OPHICERAS DEMISSUM Oppel.

(Pl. I, figs. 8, 9.)

1865. *Ammonites demissus* Oppel, Ueber ostindische Fossilreste aus den secundæren Ablagerungen von Spiti und Gnari Khorsum in Tibet, *Palæontologische Mitteil. aus dem Museum des kgl. Bayrischen Staates, Stuttgart*, I, p. 290, Taf. LXXXVI, fig. 1.

1897. *Ophiceras demissum* Diener, *Palæontol. Indica*, ser. XV, Himalayan foss., Vol. II, Pt. 1, Cephalopoda of the Lower Trias, p. 121, Pl. XIV, figs. 1—7.

1909. *O. cf. demissum* A. v. Krafft et Diener, *ibidem*, Vol. VI, Pt. 1, Lower Triassic Cephalopoda from Spiti, p. 82.

The typical form of this species differs from *Ophiceras Sakuntala* Dien. by its more numerous, slowly increasing volutions, its wider umbilicus, and by the presence of narrow, irregular wrinkles in the adolescent stage of growth. The two specimens illustrated are representatives of this typical form. The measurements of the smaller and more complete example (fig. 9) are as follows :—

Diameter of the shell		39 mm.
,, ,, umbilicus		17 ,,
Height	of the last volution	12 ,,
Thickness	of the last volution	7 ,,

The relation between the diameter of the umbilicus and the height of the last volution excludes an identification with *O. Sakuntala*. The involution is very small, the last volution overlapping the penultimate one to one-fifth of the height of the latter only.

In all specimens from Kashmir, which I prefer to unite with *O. demissum* rather than with *O. Sakuntala*, the transverse section is oval, not lanceolate. But this character having been noticed frequently in some varieties of *O. Sakuntala*, the distinction between the two species, which actually pass into each other by many transitional forms, must be based almost exclusively on the ratio of involution.

Locality, number of specimens examined.—Ophiceras layer, Pastannah, hor. **1**, 5-9-09, 8.

OPHICERAS CHAMUNDA Diener.

(Pl. I, fig. 7.)

1897. *Ophiceras Chamunda* Diener, *Palæontol. Ind.*, ser. XV, Himalayan foss., Vol. II, Pt. 1, Cephalopoda of the Lower Trias, p. 123, Pl. XII, figs. 1—4.

This species, which might be considered as an elliptical variety of *O. Sakuntala* Dien., is represented in Kashmir by a small number of specimens, agreeing in every respect with the types from the Shalshal cliff.

Locality, number of specimens examined.—Ophiceras layer, Pastannah, hor. **1**, 5-9-09, 6.

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Ophiceras cf. gibbosum Griesb.

(Pl. I, figs. 3, 10.)

1880. *Trachyceras gibbosum* Griesbach, Palæontological notes on the Lower Trias of the Himalayas, *Records, Geol. Surv. of India*, Vol. XIII, p. 111, Pl. III, fig. 10.
1897. *Ophiceras gibbosum* Diener, *Palæontol. Ind.*, ser. XV, Himalayan foss., Vol. II, Pt. 1, Cephalopoda of the Lower Trias, p. 108, Pl. IX, figs. 4—7.

A large incomplete specimen (fig. 3) from the Ophiceras layer of Pastannah, hor. **1**, 5-9-09, very closely resembles *Ophiceras gibbosum* Griesb. in its general shape and sculpture. The volutions increase less rapidly than in the typical form from the Shalshal cliff. Umbilical margin clearly defined. Transverse section cordiform in the inner whorls, becoming gradually lanceolate in the last volution. Volutions overlapping each other to the third part of their height only.

Sculpture consisting of broad knobs, which are arranged along the umbilical region of the lateral parts. Some of them assume the shape of elongated, thick folds. Their number is larger than in Griesbach's type-specimen. The irregular occurrence of the knobs and folds induces me to classify this species with *Ophiceras*, not with *Xenodiscus*, but it might be looked upon as a transitional form connecting those two genera.

A second specimen from the same locality and horizon (fig. 10) marks a transitional shape from *O. ptychodes* Dien. to *O. gibbosum*. It is a representative of the evolute variety of *O. ptychodes*, being provided with a comparatively wide umbilicus, the diameter of which is exactly equal to the height of the last volution. The ornamentation consists of regular, falciform folds arranged in the same manner as in *O. ptychodes*, but not developed sufficiently strongly to cross the siphonal part. But to those regular folds a second element of sculpture is added, which is characteristic of *O. gibbosum*. Near the aperture a large, thick bump occurs, which is accompanied by a general swelling of the whorl. Besides this several elevated and broad ribs are noticed in the penultimate volution. The latter characters seem to prove our specimen to belong to the large number of transitional forms, which connect *Ophiceras* Griesb. and *Xenodiscus* Waagen.

Ophiceras cf. tibeticum Griesb.

(Pl. I, fig. 4.)

1880. *Ophiceras tibeticum* Griesbach, Palæontological notes on the Lower Trias of the Himalayas, *Records, Geol. Surv. of India*, Vol. XIII, p. 109, Pl. III, figs. 1—7.
1897. *O. tibeticum* Diener, *Palæontologia Indica*, ser. XV, Himalayan foss., Vol. II, Pt. 1, Cephalopoda of the Lower Trias, p. 105, Pl. VIII, figs. 1—7.
1907. *O. tibeticum* Krafft et Diener, *l.c.*, Vol. VI, Pt. 1, Lower Triassic Cephalopoda from Spiti, p. 81.

A fairly complete specimen of medium size from the Ophiceras layer of Pastannah, hor. **1**, 5-9-09, reminds me very strongly of this characteristic

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species. It has a cordate transverse section, whose largest diameter corresponds exactly to the umbilical margin. The siphonal part is broadly rounded. Both in the shape of the cross-section and in the proportions of height and thickness it differs considerably from *O. Sakuntala.* The volutions are less numerous and increase in height more rapidly than in the typical form of *O. tibeticum.* In this respect our example agrees better with the variety illustrated in fig. 6 of my memoir quoted above.

The sculpture consists of umbilical bumps or knobs, from which narrow wrinkles or folds originate. It is clearly marked in the body-chamber but becomes quite indistinct in the inner volutions. It is developed much less strongly than in the typical form of *O. tibeticum*, but considerably more than in the smooth variety illustrated in fig. 2 of my memoir on the Cephalopoda of the Himalayan Lower Trias.

Dimensions.—Diameter of the shell		52 mm.
„ „ umbilicus		19 „
Height	of the last volution	19 „
Thickness	of the last volution	14 „

Sutures.—Agreeing with those of *O. tibeticum.* One-half of the last volution belongs to the body-chamber, but the apertural margin of the mouth has not been preserved.

OPHICERAS cf. MEDIUM Griesb.

(Pl. I, fig. 5.)

1880. *Ophiceras medium* Griesbach, Palæontological notes on the Lower Trias of the Himalayas, *Records, Geol. Surv. of India*, Vol. XIII, p. 111, Pl. III, fig. 9.

1897. *O. medium* Diener, *Palæontologia Indica*, ser. XV, Himalayan foss., Vol. II, Pt. 1, Cephalopoda of the Lower Trias, p. 118, Pl. IX, figs. 1, 2.

A single but fairly well preserved specimen of an *Ophiceras* resembles this species very closely, especially in the shape of its transverse section. This section is lanceolate, with the largest transverse diameter corresponding to the umbilical margin, which is sharply defined. Siphonal margin distinctly marked, although rounded off. Height of the last volution equal to the diameter of the umbilicus.

No sculpture, with the exception of a furrow, which intersects the last whorl near its anterior termination and is followed by a general swelling of the shell. The presence of this furrow reminds me of *O. stricturatum* Frech et Noetling (*Lethæa palæozoica*, II, Dyas, p. 634*f*, fig. 3). It marks probably the immediate vicinity of the apertural margin, which has, however, not been preserved.

The sutures not being known to me, I did not venture on a direct identification of this specimen with *O. medium*, notwithstanding its external similarity.

Locality, number of specimens examined.—Ophiceras layer, Pastannah, hor. 1, 5-9-09, 1.

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Gen. FLEMINGITES Waag.

FLEMINGITES sp. ind. (Group of F. Flemingianus Kon.)

Among my materials there are two body-chamber fragments of outer volutions with beautifully preserved spiral striæ. The height of the larger one is not less than 65 mm. They are provided with strong and coarse radial ribs, which are accompanied by bundles of thinner folds.

It is utterly impossible to identify the two fragments with one of the species of *Flemingites* hitherto described, taking into consideration their defective state of preservation. But they are certainly closely allied to *F. Flemingianus* L. de Koninck (*Quart. Journ. Geol. Soc. London*, Vol. XIX, p. 10, Pl. VII, fig. 1). They deserve special notice, as the group of *F. Flemingianus* is characteristic of the upper portion of the Lower Trias and has no representatives either in the Meekoceras beds of the Himalayas or in the corresponding beds of the Salt Range Ceratite formation.

Locality, number of specimens examined.—Coarse crystalline limestone, rich in corals, Guryul ravine, Khunmu, hor. **1,** 7-8-08, **2.**

FLEMINGITES (?) sp. ind. (cf. MUTHENSIS Krafft).

(Pl. VI, fig. 4.)

As far as conclusions can be drawn from the examination of the fragmentary cast before me, it exhibits the greatest similarity with the inner whorls of *Flemingites Muthensis* Krafft et Diener (*Palæontol. Ind.*, ser. XV, Himalayan foss., Vol. VI, Pt. 1, Lower Triassic Cephalopoda from Spiti, p. 108, Pl. XXII. fig. 2). It is strongly compressed, provided with a very narrow siphonal area, which is flat and bordered by acute edges, with a sagittate cross-section, and with a robust lateral sculpture. This sculpture consists of stout ribs, which are most prominent in the lower portion of the flanks and gradually becomes less marked in the direction of the siphonal margin. It is much more prominent than in equally sized specimens of *Flemingites Rohilla* Diener (*l.c.*, Vol. II, Pt. I, Cephalopoda of the Lower Trias, p. 93, Pl. XVIII, fig. 3).

My specimen being an internal cast, which is completely devoid of its original shelly test, the spiral striation characteristic of the genus *Flemingites* could not be noticed. Its true systematic position is therefore still uncertain, although there is a great probability in favour of an identity with *F. Muthensis* from the Hedenstrœmia beds of Spiti.

Locality, number of specimens examined.—E. of Guryul ravine, Khunmu, Vihi district, hor. **2,** 6-8-08, **1.**

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Gen. VISHNUITES Diener.

1897. *Vishnuites* Diener, Himalayan Foss., *Palæontol. Ind.*, ser. XV, Vol. II, Pt. 1, Cephalopoda of the Lower Trias, p. 88.

In 1897 I introduced the genus *Vishnuites* for a species from the Otoceras beds of the Shalshal cliff, which although very nearly allied to *Xenaspis* Waag. and *Ophiceras* Griesb., differs from them by its acute siphonal edge.

In 1905 the new generic name *Inyoites* was proposed by Hyatt and Smith (Triassic Cephalopod genera of America, *U. S. Geol. Surv. Prof. Papers* No. 40, p. 134) for a species from the Meekoceras beds of California, which, in my opinion, is very closely allied to *Vishnuites*, from which it can be separated only by the presence of a distinct sculpture.

VISHNUITES PRALAMBHA Diener.

(Pl. III, fig. 4.)

1897. *Vishnuites Pralambha* Diener, *Palæontol. Ind.*, ser. XV, Himalayan foss., Vol. II, Pt. 1, Cephalopoda of the Lower Trias, p. 88, Pl. VII, figs. 4, 5.

The sharp knife-like siphonal edge at once distinguishes the only specimen under description from the numerous examples of *Ophiceras*, among which it has been found. My specimen agrees in all its characters of specific importance so closely with *Vishnuites Pralambha* from the Otoceras beds of the Shalshal cliff, that I do not hesitate to identify it with that species. The umbilicus is, perhaps, a little wider, the volutions are overlapping one another to a little less than one-half their entire height.

Exactly one-half of the last volution belongs to the body-chamber, but the exact length of the latter cannot be ascertained, the apertural margin not having been preserved.

Dimensions.—Diameter of the shell		53 mm.
„ „ umbilicus		18 „
Height	of the last volution	19 „
Thickness	of the last volution	9 „

Sutures.—As far as accessible to examination, agreeing with those in *Ophiceras Sakuntala* Dien.

Locality, number of specimens examined.—Ophiceras layer, Pastannah, hor. 1, 5-9-09, 1.

Gen. INYOITES Hyatt et Smith.

INYOITES KASHMIRICUS nov. sp.

(Pl. III, figs. 8, 9.)

If *Inyoites Owenii* is taken in the wide circumscription proposed by Hyatt and Smith (Triassic Cephalopod genera of America, *U. S. Geol. Surv. Prof.*

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Papers, No. 40, p. 134, Pl. VI, figs. 1—16, LXIX, figs. 1—9, LXXVIII, figs. 1—8) the two specimens illustrated from the Lower Trias of Kashmir might perhaps be placed in the range of its variation. But the identity of the American and Indian type-specimens is, although not impossible, not ascertained, especially in consequence of their different states of preservation.

The genus *Inyoites* is provided with a long body-chamber, agreeing in this respect with *Vishnuites* Dien. This character could not be ascertained in my Himalayan types, both of them consisting of air-chambers only. According to J. P. Smith, in *Inyoites* the acute siphonal part is raised into a hollow keel. My two specimens being casts without any trace of the shelly substance, this feature is not available for examination. But in the shape of the siphonal part, which lacks the abdominal shoulder-angles, they agree entirely with the American type.

A character of real difference is, perhaps, marked in the more compressed shape of the inner whorls. J. P. Smith describes the young examples of *I. Owenii* as robust, with low, evolute whorls, and coarse lateral ribs. In my smaller specimen the measurements of the inner nucleus, corresponding with a diameter of 11·5 mm., are as follows :—

Height	of the volution	5 mm.
Thickness	of the volution	3·5 ,,

In the American type-specimen illustrated in Pl. LXXVIII, figs. 6, 7, of the monograph quoted above, the respective measurements are 5·6 and 5·2 mm., corresponding to a diameter of 17 mm. This proportion of height and thickness proves the nucleus of the American type to be more robust than the inner volutions of the Himalayan specimen. The advisability of questioning the specific importance of this insignificant difference might, however, be admitted.

The full-grown examples of *Inyoites Owenii* and of *I. Kashmiricus* agree in all their essential external characters as far as such are available for examination. The height of the whorl is twice the width. The overlap of the last volution over the penultimate one amounts to one-half of the latter. The cross-section is lenticular, the lateral parts being arched very regularly. The greatest transverse diameter is situated somewhat below the middle of the height. In my smaller specimen the width of the umbilicus is exactly one-third of the total diameter, but in my large specimen the umbilicus is slightly narrower.

In the inner volutions the surface is covered with strong, narrow lateral ribs, which extend from the umbilicus into the marginal region, but do not cross the siphonal edge. The anterior half of the last volution is smooth.

Dimensions.—Diameter of the shell		64 mm.
,, ,, umbilicus		18 ,,
Height of the last volution	above the umbilical suture	27 ,,
	,, ,, preceding whorl	20 ,,
Thickness of the last volution		14 ,,

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Sutures.—Ceratitic, with lobes deeply serrated and saddles entire. Siphonal lobe very broad and divided by a high median prominence, but less deep than the lateral saddle. Second lateral saddle comparatively small and low. Auxiliary series forming a straight, serrated line as in many species of *Ophiceras*. In the arrangement of this lobe the American types illustrated by J. P. Smith do not completely agree with our Himalayan examples. But it is well known that in *Meekoceratidæ* the arrangement of the auxiliary series is subject to considerable variation and is therefore not a character of paramount specific importance (*vide* Diener and Krafft, Lower Triassic Cephalopoda from Spiti, Himalayan Foss., *l.c.*, Vol. V, Pt. 1, p. 61).

Locality, number of specimens examined.—Pastannah, probably from the Ophiceras layer, hor. **1,** 5-9-09, but eventually from loose blocks, × 4-9-09, **2.**

Remarks.—A species of *Inyoites* from the shales with *Xenodiscus cf. lissarensis* Dien. near Langson (Tonking) is mentioned as *I. cf. Owenii* by Mansuy (*Contribution à la Carte géologique de l'Indochine, Service des Mines, Hanoi-Haiphong*, Paléontologie, p. 64, Pl. XVI, fig. 14). Special stress is laid by the author on the close agreement with the type illustrated by A. Hyatt and J. P. Smith in Pl. VI, fig. 3, of their memoir quoted above. The species from Tonking is certainly allied very nearly both to the American form and to the species from Kashmir. But its indifferent state of preservation excludes any attempt at a safe determination.

Gen. Hungarites Mojs.

Hungarites Middlemissii nov. sp.

(Pl. III, figs. 5, 6, 7.)

From loose blocks in the detrital fans near Pastannah forty well preserved specimens of an Ammonite were collected by C. S. Middlemiss, which he correctly attributed to the genus *Hungarites* Mojs. The species, for which his name is proposed here, is, indeed, a typical representative of this genus.

Shell compressed, involute, discoidal. Siphonal part roof-shaped, with a median keel and two distinct marginal edges. The siphonal keel makes its appearance in very early stages of growth. Inner nuclei of 6 mm. in diameter are provided with acute siphonal edges. In small examples the greatest transverse diameter corresponds to the middle of the flanks, but in full-grown examples it is gradually shifted towards the upper portion of the cross-section and into the vicinity of the marginal edges. Umbilical wall low, but vertical, passing into the sides with an obtusely rounded off edge. Inside the small umbilicus numerous inner volutions are exposed in the shape of narrow spiral bands.

Young examples are perfectly smooth. In later stages of growth the surface is covered with thin, falciform folds. In my largest specimens (fig. 6) these folds are developed more strongly in the vicinity of the aperture, and some of them are

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even raised into distinct tubercles before reaching the marginal edges, where the sculpture disappears completely.

Dimensions.—Diameter of the shell		42 mm.
„ „ umbilicus		8 „
Height of the last volution	above the umbilical suture	18 „
	„ „ preceding whorl	12 „
Thickness of the last volution		10 „

Sutures.—Although a very large number of individuals is available for examination, I have not succeeded in developing the sutural line in a satisfactory manner. The sutures are ceratitic, with entire saddles, but the details of their arrangement are not known to me.

Locality, number of specimens examined.—Pastannah loose blocks, exact horizon not known, × 4-9-09, ab. 40.

Remarks.—In the present species the two flanks of the siphonal part slope regularly from the median keel towards the marginal edges, without being interrupted by any furrow. This proves our species to belong to *Hungarites s.s.*, not to the Alpine group of *Ceratites rusticus* Hauer (*Halilucites* Dien.).

G. v. Arthaber (*Beitræge zur Geol. u. Palæontol. Œsterr.-Ungarns*, etc., XII, p. 220) has given a good synopsis of the genus *Hungarites* and of its gradual evolution from the Permian to the top of the Middle Triassic. Comparing our species with the congeneric forms in G. v. Arthaber's memoir, we find it to hold an intermediate position between the Armenian types from Djulfa and the Siberian group of *H. triformis* v. Mojsisovics (Arktische Triasfaunen, *Mém. Acad. impér. des sciences St. Pétersbourg*, sér. VII, T. XXXIII, No. 62, p. 87, Pl. XI, figs. 14, 15, 16). With the Permian species, namely, *Hungarites Raddei* Abich, *H. pessoides* Ab., it agrees in the tripartite arrangement of the siphonal part, which remains unchanged during all stages of growth. It is similar to *H. triformis* in the remarkable change of its transverse section in the body-chamber of full-grown individuals. But otherwise it must be kept separated from the latter group, which is distinguished by the absence of marginal ridges and has no representatives either in the Alpine or in the Indian Trias.

The three oldest species of *Hungarites*, *H. Raddei*, *H. pessoides* and a third unnamed form from Djulfa, which has been described by G. v. Arthaber, are easily distinguished from *H. Middlemissii* by their different cross-section. *H. Raddei* has a very narrow umbilicus, *H. pessoides* is widely umbilicate, but in both of them the flanks run nearly parallel for a considerable distance from the marginal edges, and the region of greatest width corresponds to a broad belt, which is bordered by two spiral depressions. The only fragment of *Hungarites* from the Otoceras beds of the Shalshal cliff (Diener, Cephalopoda of the Lower Trias, Himalayan Foss., Vol. II, Pt. 1, p. 150, Pl. XXIII, fig. 5) has a helmet-shaped cross-section, with lateral parts flatly convex and diverging strongly.

Two species from the Lower Muschelkalk of Ismid (Asia Minor) appear to be more closely allied to the present one, namely, *Hungarites proponticus* Toula

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(Eine Muschelkalkfauna am Golf von Ismid in Kleinasien, *Beitræge zur Geol. u. Palæontol. Oesterr.-Ungarns*, etc., X, p. 176, Taf. XXI, figs. 5, 6) and *H. Solimani* Toula (*ibid.*, Taf. XXI, figs. 3, 4), but in both of them the umbilicus is still narrower, the greatest width is situated in the vicinity of the umbilical region, or at least in the lower portion of the cross-section, and the sculpture either consists of straight, not falciform ribs, or is completely absent.

Hungarites Middlemissii is certainly an independent species, which is not very closely allied to any of the congeneric forms hitherto described.

Gen. MEEKOCERAS Hyatt.

The genus *Meekoceras*, in the wide circumscription proposed by myself in 1897 and adopted by A. v. Krafft and J. P. Smith, is frequently represented in the Himalayan collections from Kashmir, but unfortunately, by fragmentary examples only, all of them preserved so unsatisfactorily, that not in one single case can I venture on a direct identification. Three specimens belonging to an involute form with a biangular cross-section, but specifically indeterminable, were discovered among the materials brought by Mr. C. S. Middlemiss from the Ophiceras layer near Pastannah (hor. **1**, 5-9-09). All the rest were found in the layer containing *Flemingites* (group of *F. Flemingianus* Kon.), E. of Guryul ravine, Khunmu, Vihi district, corresponding in age probably to the Hedenstrœmia beds of Spiti and Painkhanda.

MEEKOCERAS sp. ind aff. JOLINKENSE Krafft et Diener.

(Pl. IV, fig. 3.)

Two fragmentary specimens, consisting of air-chambers only, are before me. In their outlines, transverse section and in the complete absence of ornamentation they closely resemble *Meekoceras jolinkense* Krafft et Diener (*Palæontol. Ind.*, ser. XV, Himalayan Foss., Vol. VI, Pt. 1, Cephalopoda of the Lower Trias from Spiti, etc., p. 37, Pl. IV, fig. 3, XIV, fig. 13, var. III, fig. 2, XXX, fig. 6).

The thickness of the cross-section is a little more than half its height. Greatest transverse diameter below the middle of the height. Lateral parts flatly arched and separated from the umbilicus by a high and steep wall, which is bordered by a sharply rounded-off margin. Siphonal area moderately broad and bordered by distinct marginal edges.

Dimensions.—Diameter of the shell		31 mm.
,, ,, umbilicus		7 ,,
Height	of the last volution	15 ,,
Thickness	of the last volution	9 ,,

Sutures.—Strongly weathered, but agreeing in their general arrangement with those of *M. jolinkense*, as far as accessible to examination.

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Remarks.—*Meekoceras jolinkense* is known with certainty from the chocolate limestone of Byans, but varieties have been found both in the Meekoceras beds of Lilang and in the exotic block No. 20 in Malla Johar.

MEEKOCERAS (KONINCKITES) cf. YUDISHTHIRA Dien.

(Pl. IV, fig. 2.)

1897. *Meekoceras (Koninckites) Yudishthira* Diener, *Palæont. Ind.*, ser. XV, Himalayan foss., Vol. II, Pt. 1, Cephalopoda of the Lower Trias, p. 141, Pl. XXII, fig. 1.
1909. *Koninckites Yudishthira* Krafft et Diener, *ibidem*, Vol. VI, Pt. 1, p. 65, Pl. XIV, fig. 3, XV, figs. 3, 4, 5.

The only specimen available for examination is greatly weathered and fragmentary. But, so far as it can be compared with *Koninckites Yudishthira* Dien. from the Hedenstrœmia beds of Spiti, it bears a striking similarity with that species. The proportions of the involution and transverse section are practically identical. The siphonal part has been preserved in a single place only, near the commencement of the last volution, where it is rounded all over, as in my type-specimen from Muth. In the inner whorls an obtusely rounded-off umbilical edge separates the flanks from a moderately high and steep umbilical wall, but in the last volution the umbilical region has been injured by weathering so much, that the demarcation between lateral parts and umbilical wall has been almost entirely destroyed.

The last volution consists of air-chambers only and is quite smooth.

Dimensions.—Diameter of the shell	134 mm.	
„ „ umbilicus	31	„
Height of the last volution — above the umbilical suture	65	„
Height of the last volution — „ „ preceding whorl	49	„
Thickness of the last volution	30	„

Sutures.—Greatly injured by weathering, not exhibiting the details of denticulation in the lobes. In their general arrangement the sutures agree with those of *K. Yudishthira*. Siphonal lobe not known. Second lateral saddle skew-shaped and broadly rounded above. First auxiliary lobe followed by a distinctly individualised saddle, which is entire and resembles in shape the second lateral saddle.

Locality, number of specimens examined.—E. of Guryul ravine, Khunmu, Vihi district, hor. **2**, 6-8-08, **1**.

MEEKOCERAS (ASPIDITES) sp. ind. (Group of A. KINGIANUS Waag.)

(Pl. V, fig. 1.)

Only a single fragmentary specimen, consisting entirely of air-chambers, is available for description, but it is sufficiently well preserved to ascertain its affinity with *Aspidites Kingianus* Waagen (*Palæont. Ind.*, ser. XIII, Salt Range Foss., Vol. II, Ceratite formation, p. 225, Pl. XXXII, fig. 1; XXXIII, fig. 1).

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The umbilicus is of large size, the overlap of the last whorl over the penultimate one amounting to just one-third of the entire height of the former. Lateral parts regularly and moderately curved. Largest transverse diameter situated below the middle of the height. Umbilical wall low, uniting with the lateral parts in a regular curve, without intervention of a distinct umbilical margin. Siphonal area rounded, not bordered by marginal edges nor shoulders.

The ornamentation, if once present, has been completely destroyed. My specimen is a weathered cast, without any trace of the original shelly test.

Dimensions.—Diameter of the shell	87	mm.
„ „ umbilicus	25	„
Height of the last volution } above the umbilical suture	39	„
Height of the last volution } „ „ preceding whorl	27	„
Thickness of the last volution	27	„

Sutures.—Not completely known, but the most important elements clearly exposed. Second lateral lobe deep and strongly serrated, with two denticulations of remarkable size in its base. Auxiliary series standing considerably higher than the second lateral lobe and consisting of irregular denticulations, which are rather variable in the different septa.

Locality, number of specimens examined.—E. of Guryul ravine, Khunmu, Vihi district, hor. **1,** 6-8-08, 1.

Remarks.—This species appears to be very closely allied to *Aspidites Kingianus* Waag. from the Stachella beds of the Ceratite sandstone, and with better materials at hand, might even prove identical. No characters of difference have been noticed, to which a specific importance could be reasonably attributed. But with such fragmentary materials at hand it is impossible to decide the question of identity. We can only say that the group of *Aspidites Kingianus* is represented by the present species in the Flemingites bed of Kashmir.

Meekoceras pl. sp. ind.

Among the collections made by Mr. C. S. Middlemiss in the Flemingites layer E. of Guryul ravine, Khunmu, hor. **1—4,** 6-8-08, there are, besides the types described above, a number of examples so imperfectly preserved that not even the group of Meekoceras, to which they actually belong, can be fixed. But on account of the scarcity of fossils known from that bed, and of the interest connected with its discovery, they are briefly described here.

One of the specimens might be compared with *Meekoceras pulchrum* Waagen (Ceratite formation, *l.c.*, p. 249, Pl. XXVII, figs. 2, 3, XXIX, fig. 1). It is provided with a moderately wide umbilicus, with a diameter of 17·5 mm. corresponding to a diameter of the entire cast of 70 mm. It shows remarkable variations in the shape of its transverse section in different stages of growth. In the inner volutions the siphonal part is regularly rounded, no marginal shoulders being developed. In the last volution, however, acute siphonal margins appear and persist throughout this volution.

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The fragment is an internal cast, without any trace of the shelly substance.

Sutures.—Not visible.

A second specimen reminds me of *Meekoceras* (*Aspidites*) *Vidarbha* Diener (Himalayan Foss., *l.c.*, Vol. II, Cephalopoda Lower Trias, Pt. 1, p. 139, Pl. VII, fig. 8). It agrees with this species if taken in the circumscription proposed by A. v. Krafft (*l.c.*, Vol. VL, Pt. 1, Lower Trias Cephalopoda from Spiti, p. 63) in its peculiar sculpture, consisting of radial, slightly falciform folds, in its involution, and in its transverse section, having the lower portion of the sides strongly compressed. But the umbilicus of my specimen is wider, and the siphonal area is highly rounded, not flattened, nor bordered by marginal edges. There is consequently no proof of a real affinity between my species from the Lower Trias of Kashmir and *Aspidites Vidarbha*.

Gen. Pseudosageceras Dien.

Pseudosageceras clavisellatum nov. sp.

(Pl. IV, figs. 5, 6.)

This species represents an interesting type, agreeing very closely with *Pseudosageceras multilobatum* Noetling (*Palæontographica*, LI, p. 181, Taf. XIX—XXVII) in its external characters, but differing from it in some important details of the sutural line.

The species is represented by two specimens, both of them completely chambered. They are compressed very strongly, of discoidal shape, provided with a very narrow umbilicus. The siphonal part is raised into two low, acute keels. which are separated by a narrow furrow. This is exactly the shape of the siphonal part, as it is seen in the majority of examples of *P. multilobatum*, the number of individuals with an acute siphonal edge being comparatively small (*vide* A. v. Krafft et Diener, Lower Trias Cephalopoda from Spiti, Himalayan foss., Vol. VI, Pt. 1, p. 145, Pl. XXI, fig. 5). Greatest transverse diameter situated in the vicinity of the umbilical region. The overlap of the last whorl over the penultimate one amounts to two-fifths of the entire height of the former.

In my smaller specimen the original shelly test has been preserved. Its surface shows a delicate ornamentation, consisting of falciform striæ, resembling the sculpture in many species of *Beyrichites*, *e.g.*, in *B. affinis* Mojs. (*vide* Diener, Himalayan foss., *l.c.*, Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, Pl. VIII, figs. 4, 5).

Dimensions.—Diameter of the shell		46 mm.
,, ,, umbilicus		1 ,,
Height of the last volution	above the umbilical suture	26·5 ,,
	,, ,, preceding whorl	17 ,,
Thickness of the last volution		9 ,,

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Sutures.—In following the terminology proposed by Noetling and adopted in our memoir quoted above, we come to the following classification of the elements in this extremely complicated sutural line.

L, the deepest lateral lobe, is situated not very far from the middle of the lateral parts. It is tripartite, the central digitation being the largest. The lateral digitations are serrated irregularly.

E, comprising all the lobes included between *L* and the median line of the siphonal part, is divided into five adventitious branches. E_1 and E_2 are very broad and low, with their bases serrated irregularly. The three following lobes are increasing regularly in depth and distinctly bipartite. In E_3 the two digitations are entire, E_5 and E_4 are asymmetrically bipartite, the inner digitations being provided with a larger number of secondary indentations.

H, corresponding to the lobes between *L* and the umbilical suture, are either bipartite or flatly rounded. H_1 is deeply bipartite, the broad digitations being obtusely serrated at their base.

e, the external saddle situated between *L* and *E*, is the highest. This and the adjoining adventitious saddles m_2, m_3, m_4 are club-shaped, with acutely rounded tops, and laced at their base considerably. The adventitious saddle m_1 only, which is of very small size, is provided with parallel margins.

Among the saddles between *L* and the umbilical suture i_1 agrees with *e* in its shape. The following saddle i_2 is lanceolate, all the rest of the saddles are bordered by parallel margins. Eight saddles have been counted between *e* and the umbilical suture.

Locality, number of specimens examined.—Ophiceras layer, Pastannah, hor. 1, 5-9-09, 2.

Remarks.—In the general arrangement of the sutural line this species is very closely allied to *P. multilobatum*. The chief difference consists in the character of the saddles m_2—m_4, e and i_1, which are distinctly club-shaped. In the specimen of *P. multilobatum* from the Hedenstrœmia beds of Muth, Spiti, some of the adventitious saddles adjoining *L* are also club-shaped, but none of them is laced at its base as strongly as in the present species. The contrast between the ventral and dorsal saddles is, indeed, so conspicuous in the latter, that it may be safely considered as a leading feature of specific importance.

Another character of difference is the width of E_1 and E_2, which are divided by a very low saddle only.

PSEUDOSAGECERAS sp. ind.

(Pl. IV, fig. 7.)

This is the chambered fragment of an individual of very large dimensions, in which neither the siphonal nor the umbilical region has been preserved. That it belongs to the genus *Pseudosageceras* Dien. is evident from the arrangement of its sutural line. Of the sutural elements only three lobes of the group *H* and five

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saddles of the group *i* are accessible to examination. The lobes are all bipartite, the saddles slender and bordered by parallel margins.

My materials are too insignificant to allow a closer comparison with any of the congeneric species hitherto described.

Locality, number of specimens examined.– Flemingites layer, E. of Guryul ravine, Khunmu, hor. **1,** 6-8-08, **1.**

Gen. Prionites Waag.

Prionites Guryulensis nov. sp.

(Pl. IV, fig. 1.)

There is a tolerably well preserved specimen of this species at my disposal. In its general shape, involution, and in the arrangement of the sutural line it agrees with *Prionites* Waagen (Salt Range Foss., *Palæontol. Indica*, ser. XIII, Vol. II, Ceratite formation, p. 52), without, however, being identical with any of the congeneric species from the Ceratite beds of the Salt Range.

In its involution and transverse section it shows a remarkable resemblance to *Prionites undatus* Waagen (*l.c.*, p. 60, Pl. V, fig. 1). The whorls overlap one another more considerably than in the Salt Range species, to almost two-thirds of their entire height. Nevertheless the umbilicus is widely open, its diameter measuring about one-quarter of the diameter of the entire shell, exactly as in *P. undatus*. Cross-section trapezoidal, considerably higher than broad, with a flattened siphonal area, which is separated from the lateral parts by obtusely rounded marginal shoulders. Greatest transverse diameter situated below the middle of the height. From this place the lateral parts slope in a regular curve both towards the marginal shoulders and the umbilical suture, without intervention of a distinct umbilical margin.

No trace of sculpture has been noticed in my specimen. This is a cast without the shelly test and partly injured by weathering, but the original ornamentation, if any such has been present, must certainly have been more delicate than in any of the congeneric species from the Ceratite formation.

One-third part of the last volution belongs to the body-chamber.

Dimensions.—Diameter of the shell		86 mm.
,, ,, umbilicus		23 ,,
Height of the last volution	above the umbilical suture	34 ,,
	,, ,, preceding whorl	24 ,,
Thickness of the last volution		26 ,,

Sutures.—The sutures can be seen quite clearly in the last septum only, bordering the posterior termination of the body-chamber. Auxiliary series consisting of a number of denticulations, which are arranged along a straight line and do not show any differentiation into distinct lobes and saddles. Siphonal lobe not accessible to examination. Lobes serrated, saddles entire. The principal lateral saddle is the largest.

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Sutures as far as known, agreeing almost entirely with those of *P. undatus.*

Locality, number of specimens examined.—E. of Guryul ravine, Khunmu, hor. **1,** 6-8-08, **1.**

Remarks.—The present species must be grouped with *Prionites* on the strength of its inflated shape, its trapezoidal transverse section and its prionitic umbilical lobe, although it has no distinct sculpture. But from such species of *Meekoceras,* as are provided with a prionitic auxiliary series (*Prionolobus* Waagen), it differs thoroughly by the characters enumerated above.

The absence of any distinct sculpture does not permit an identification of the present species with any of the congeneric forms described by Waagen. *Ceratites inflatus* Waagen (*l.c.*, p. 40, Pl. X, fig. 1), it is true, might, perhaps, also be compared to it, but the systematic position of that species, which A. v. Krafft is inclined to include in the genus *Sibirites,* is as yet quite uncertain.

The unnamed species of *Prionites* from the Hedenstrœmia beds of Muth, Spiti, which has been described in our memoir on the Lower Triassic Cephalopoda from Spiti (*l.c.*, Vol. VI, Pt. 1, p. 120, Pl. XXVII, fig. 1) differs from *P. Guryulensis* by the development of a marginal sculpture and by its more compressed shape.

Gen. Sibirites Mojs.[1]

Sibirites Kashmiricus nov. sp.

(Pl. V, fig. 7.)

Although there is but one specimen, which consists of air-chambers only, available for a description of this species, I think myself justified in introducing a new specific name, as the characters of importance are all well marked.

The present species is probably allied to *Sibirites spiniger* Krafft et Diener (Himalayan Foss., *Palæontol. Ind.*, ser. XV, Vol. VI, Pt. 1, Cephalopoda of the Lower Trias from Spiti, p. 131, Pl. XXXI, figs. 2, 7), from which it differs chiefly by the absence of lateral spines and by the rare occurrence of dichotomous ribs. There are also affinities with *S. ibex* Waagen (Ceratite Form., *Pal. Ind.*, ser. XIII, Salt Range Foss., Vol. II, p. 121, Pl. IX, fig. 3), but from this species the present one is easily distinguished by the larger number and distinctly falciform shape of the ribs.

Whorls involute, the last volution overlapping the penultimate one to about one-half its height. Cross-section compressed, trapezoidal. Greatest transverse diameter either corresponding to the umbilical margin or situated somewhat above. Lateral parts arched very flatly and separated by sharp margins from the siphonal area and umbilical wall. Siphonal area broad and almost flat. Umbilical wall low and vertical.

[1] In accordance with the remarks of A. v. Krafft I do not consider the sub-generical separation of *Anasibirites* and *Sibirites* justified on sufficient grounds.

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Sculpture consisting of prominent falciform ribs, which cross the siphonal area without diminishing in height and width. They reach, however, their greatest strength in the lower region of the flanks, but are not elevated into knobs or tubercles. The majority of ribs remain undivided. Bifurcating and intercalated ribs are noticed but rarely.

Dimensions.—Diameter of the shell		45 mm.
,, ,, umbilicus		11 ,,
Height	of the last volution	18 ,,
Thickness	of the last volution	16 ,,

Sutures.—Ceratitic, with serrated lobes and entire saddles. Siphonal lobe broad, with a large median prominence. Bases of the lateral lobes not symmetrical, but sloping more steeply towards the internal magins. A denticulated auxiliary lobe and a small auxiliary saddle outside the umbilical suture.

Locality, number of specimens examined.—E. of Guryul ravine, hor. **1**, 6-8-08, **1**.

Remarks.—In some of its prominent features this species shows a remarkable resemblance to *Ceratites* (*Gymnotoceras*) *laqueatus* Lindstr. (E. v. Mojsisovics, Arktische Triasfaunen, *Mém. Acad. imp. d. sciences, St. Pétersbourg*, sér. VII, T. XXXIII, No. 6, p. 51, Pl. IX, figs. 1, 2) of the group of *Ceratites geminati*. In their general shape, involution, lateral sculpture and sutures the two species agree pretty well. A character of distinction is, however, found in the different ornamentation of the siphonal area. In *Gymnotoceras laqueatum* the ribs do not cross the siphonal area in a straight line, as in *S. Kashmiricus* or in *S. ibex* Waag., but describe a semicircular curve, with its convexity turned forward. The apex of this convexity corresponds to an indistinct keel, of which no traces have been noticed in my Himalayan species.

SIBIRITES sp. ind. aff. IBEX Waag.

(Pl. IV, fig. 8.)

My materials of this species are, unfortunately, extremely scanty, but on account of the great interest connected with the discovery of *Sibirites* in the Lower Trias of Kashmir, they deserve a special description.

The specimen illustrated, although very imperfectly preserved, clearly shows the characters peculiar to the genus *Sibirites*. It is flatly disciform, with an approximately rectangular cross-section. The flatly rounded area is bordered by marginal shoulders, which are rounded off obtusely. Lateral parts almost flat. No distinct umbilical margin.

Sculpture consisting of numerous radial ribs which rise in the lower third of the lateral parts, at some distance from the umbilical suture, and extend to the marginal shoulders, where they are most strongly developed. The siphonal area has, unfortunately, been destroyed in so many places, that it is difficult to follow

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the lateral ribs across it, but in a few spots they are clearly seen to cross the siphonal part in the shape of straight, elevated, uninterrupted folds. This is a character of ornamentation, which somewhat resembles the sculpture in *Sibirites ibex* Waagen (Salt Range foss., *Palæont. Ind.*, ser. XIII, Vol. II, Ceratite formation, p. 121, Pl. IX, fig. 3), but there can be no question of identity, the ribs being less numerous and stronger in the species from the upper Ceratite limestone of Chidru.

Among the congeneric species from the chocolate limestone in Byans (topmost beds), there is none with a similar ornamentation, which is conspicuous by the absence of any spines or tubercles and by the development of straight ribs.

Dimensions.—Diameter of the shell		32 mm.
,, ,, umbilicus		9 ,,
Height	of the last volution	14 ,,
Thickness	of the last volution	8 ,,

Sutures.—Apparently goniatitic, the original denticulations of the lobes having been obliterated probably by weathering. All the saddles broadly rounded. Second lateral and umbilical lobes very narrow. Principal lateral lobe broad and deep.

The anterior half of the last volution belongs to the body-chamber.

Locality, number of specimens examined.—Mandakpal, hor. **4,** 14-8-08, 1.

Gen. KASHMIRITES nov. gen.

In the Flemingites layer E. of Guryul ravine, Khunmu, hor. **1—4,** 6-8-08, a considerable number of *Ammonea trachyostraca* have been found, all of them, unfortunately, either fragmentary or badly preserved, which undoubtedly belong to the group of *Celtites subrectangularis* Waag. or *Celtites armatus* Waagen from the Ceratite formation of the Salt Range. This group of forms has been united with *Celtites* by Waagen on the strength of a diagnosis of the genus *Celtites* given by E. v. Mojsisovics in 1882 (Cephalopoden Mediterran. Triasprovinz, *Abhandl. k. k. Geol. Reichsanst.*, X, p. 145). In his exhaustive monograph of the Triassic Cephalopoda from Hallstatt (*l.c.*, VI, Pt. 2, p. 346) E. v. Mojsisovics proposed a narrower interpretation of *Celtites*, which necessarily excludes the Indian species from that genus. I consider them as representatives of a new genus, for which the name of *Kashmirites* is proposed here.

No complete example of *Kashmirites* has been found among my Himalayan materials collected in the Flemingites layer of Khunmu by C. S. Middlemiss. But the number of fragments is so considerable, that from their combination a fairly good idea of the characteristic features of two species at least can be gathered.

Waagen (Salt Range Foss., *Palæont. Ind.*, ser. XIII, Vol. II, Ceratite form, p. 68) states that the body-chamber in the Salt Range species grouped by him with *Celtites* Mojs. comprises one entire volution or a little less in length. My

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materials did not offer me an opportunity for studying this feature. In several fragments a body-chamber has been noticed, exceeding one-half volution in length, but without the apertural margin of the mouth having been preserved.

There is, undoubtedly, a general resemblance between *Kashmirites* and *Celtites*, but to me still closer affinities seem to exist between the present genus and *Xenodiscus* on the one hand and *Sibirites* on the other.

If we compare typical species of *Kashmirites armatus* Waag. or *K. Blaschkei* Dien. with *Xenodiscus Purusha* Dien. (*Palæont. Ind.*, ser. XV, Himalayan foss., Vol. II, Pt. 1, Cephalopoda Lower Trias, p. 30, Pl. XV, figs. 14, 15), we find a remarkable agreement in many features of generic importance. The slowly increasing whorls, which barely overlap each other, the wide umbilicus, the rectangular cross-section, the broad and flatly rounded siphonal area, the lateral sculpture, and even the arrangement of the sutural line are all characters which are noticed both in *Xenodiscus Purusha* and in *Kashmirites*. In *X. Althothæ* Dien. and in *X. Comptoni* Dien. even a distinct sculpture is developed in the siphonal region, in the body-chamber of the first species the siphonal area being crossed by the lateral ribs without interruption.

There is, indeed, a very strong probability for a direct developmental connection between those two groups of Ammonites. This probability is corroborated by the fact that inner nuclei of *Kashmirites* are often provided with smooth siphonal parts.

I wish to separate *Kashmirites* from *Xenodiscus* because of its more strongly inflated shell and of the presence of a distinct sculpture along the siphonal area. Especially the strongly inflated volutions impart to the typical species of *Kashmirites* an external shape so peculiar and differing from the type of *Xenodiscus* (*X. plicatus* Waag.) so considerably, that I think myself justified in separating them from *Xenodiscus* and in elevating them to the rank of a proper genus.

There are also close affinities with the genus *Sibirites* Mojs., which is probably also a descendant from either *Meekoceras* or *Xenodiscus*. The siphonal sculpture is developed yet more strongly in *Sibirites*, and intercalated or bifurcating external ribs, which are absent in *Kashmirites*, play a very important part in this ornamentation.

Kashmirites Blaschkei nov. sp.

(Pl. III, figs. 11, 12.)

One specimen, with its body-chamber preserved, but with incomplete inner volutions, one fragment of a chambered whorl of middle size, and two inner nuclei are available for examination. Thus we are able to reconstruct the characters of the entire shell in a satisfactory way.

This is one of the largest species of the genus, reaching the dimensions of *Kashmirites armatus* Waagen (Fossils from the Ceratite formation, *l.c.*, p. 75, Pl. VII, figs. 1, 7). The volutions overlap one another but very little agreeing in

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this respect with either *Celtites* or *Xenodiscus*. They are of a squarish transverse section, of nearly equal height and width. Although they increase rather slowly, the dimensions of the last whorl at its commencement and anterior termination differ so considerably, that the umbilicus is not only wide, but also remarkably deep, the coils being separated by high and vertical walls. The section is not exactly rectangular, but a little wider in the umbilical than in the marginal region. Both the umbilical and siphonal margins form distinct edges. Siphonal area very flatly arched, lateral parts forming flat planes. Umbilical edge separated from the umbilical suture by a high and perpendicular wall.

All the specimens at my disposal are internal casts, without any trace of the shelly test preserved.

In my body-chamber fragment the sculpture (fig. 11) consists of very numerous ribs of moderate strength. The majority of ribs are straight and of nearly radial direction in the umbilical region, but slightly turned forward in a falciform curve in the vicinity of the siphonal margin. They cross the siphonal area in a flat curve with its convexity turned forward. But there their original strength is diminished considerably, although they are not interrupted along the middle of the siphonal part, as far as we may judge from an examination of such places, where the surface of the cast has been left uninjured by weathering. Some of the ribs are dichotomous, bifurcating in the umbilical margin, whereas the majority remain undivided. But I have never seen a second bifurcation in the vicinity of the siphonal margin, as it is noticed rather frequently in *Sibirites*.

The fragment of an inner volution, with part of the umbilicus adhering to it (fig. 12), exhibits exactly the same pattern of sculpture as the full-grown individual, but the folds are more delicate. The cross-section is less distinctly rectangular. There is a greater disproportion in the distance of the siphonal and umbilical margins than in old age. The umbilical margin is still acute, but the siphonal margin is bluntly rounded off and the siphonal area is not flattened as strongly as in the adult individual.

The inner nuclei agree very closely with the fragment described, but their ornamentation is still more delicate. In one of the two nuclei the surface of the cast is even nearly smooth.

From this examination of different stages of growth it is evident that the sculpture in *K. Blaschkei* is acquired gradually, according to the growth of the shell, and that it reaches its maximum in the adult stage. There is no distinct change in the ornamentation known to me throughout the entire development of this species.

Dimensions.—Diameter of the shell		46 mm.
,, ,, umbilicus		18 ,,
Height	of the last volution	14 ,,
Thickness	of the last volution	16 ,,

Sutures.—The sutural line, which has been preserved in rude traces only, appears to be very simple. A broad siphonal and two lateral lobes only are

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present. They are probably goniatitic, at least I have not been able to find any denticulations. Siphonal saddle higher than the principal lateral, both of them being provided with margins converging from their bases towards the narrowly rounded tops.

Locality, number of specimens examined.—E. of Guryul ravine, Khunmu, hor. **1—2,** 6-8-08, 4.

KASHMIRITES SUBARMATUS nov. sp.

(Pl. III, fig. 13; V, figs. 2, 3.)

This species is represented by several complete inner nuclei and full-grown specimens, all of them, unfortunately, fragments only. It is allied very closely to *Kashmirites* (*Celtites*) *armatus* Waagen (Ceratite form, *l.c.*, p. 75, Pl. VII, figs. 1, 7) from the Ceratite sandstone of Chidru.

In its general shape, involution and in the outlines of the cross-section our species agrees fairly well with *K. armatus*. The umbilicus is impressed less deeply than in *K. Blaschkei*. Umbilical margin acute, siphonal margin obtusely rounded. Greatest transverse diameter corresponding to the umbilical edge.

It is especially in some of the inner nuclei that the siphonal area is arched more distinctly than in the full-grown individuals. Lateral parts flat.

Sculpture consisting of single, radial ribs, which originate in the umbilical edge and run in a straight direction towards the siphonal margin, where they are slightly turned forward and rise occasionally into indistinct tubercles. Some ribs are also elevated above the general level at the place, where they originate near the umbilical edge. In the inner nuclei the ribs attain their greatest strength in the umbilical region and become gradually obsolete before reaching the siphonal margin (Pl. V, fig. 2), but in adult individuals the majority of ribs are of equal strength during their entire extent. In the specimen illustrated in Pl. V, fig. 3, the swellings of the last ribs preceding the aperture are, however, very conspicuous, both in the umbilical and siphonal terminations. The siphonal area is not smooth, but crossed by the ribs symmetrically from either side. The external ribs are, however, considerably inferior in strength to the lateral ones.

The sculpture—and this is the chief difference from the ornamentation noticed in *K. armatus*—is very irregular, not only in different specimens, but often in the same individual, according to different stages of growth. In young specimens, as a rule, the ribs are less numerous and, consequently, arranged at greater distances than in full-grown individuals. The inner nucleus illustrated in Pl. V, fig. 2, is not an extreme type in this respect, although several inner nuclei with a larger number of ribs have been found. The best instance of the remarkable irregularity in the sculpture is the specimen illustrated in Pl. V, fig. 3. At the commencement of the last volution the number of ribs is very small, not larger proportionately than in the nucleus mentioned above.

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The ribs are stout and of equal strength throughout. In the remaining portion of this whorl the ribs are crowded, resembling in this character the body-chamber fragment illustrated in Pl. III, fig. 13, and lower.

In the anterior region adjoining the aperture the ribs again become less numerous and stout and are elevated considerably along the siphonal and umbilical margins.

Dimensions.—The measurements of my largest specimen are as follows:—

Diameter of the shell	51 mm.
„ „ umbilicus	21 „
Height } of the last volution	16 „
Thickness } of the last volution	18 „

Sutures.—The sutural line is well preserved in the specimen illustrated in Pl. V, fig. 3, especially in the last septa. Lobes elongated and narrow. Principal lateral lobe with three distinct denticulations in its base. Two lateral lobes and saddles and a small auxiliary lobe outside the umbilical suture. Siphonal and principal lateral saddles of nearly equal size. Second lateral saddle considerably smaller.

Locality, number of specimens examined.—E. of Guryul ravine, Khunmu, hor. **1—4,** 6-8-08, 10.

Remarks.—The present species, although allied very closely to *K. armatus* Waag., can be distinguished from it by the presence of an acute umbilical edge and by the irregularity of its sculpture, which, in full-grown examples at least, consists of more numerous ribs, which are not quite straight, but, as a rule, turned forward slightly in the marginal region of the shell.

KASHMIRITES sp. ind. aff. SUBARMATO Dien.

(Pl. V, fig. 5.)

The only specimen serving for a description of this species is fragmentary and has been badly injured. It is, however, evident from a comparison with *Kashmirites subarmatus* Diener that its whorls are inflated more strongly and that it was provided with a narrower umbilicus.

The sculpture, although agreeing in general with that seen in *K. subarmatus*, is distinguished by a more bulky shape of the lateral ribs and by the very remarkable change in the ornamentation in the vicinity of the aperture. The pattern of sculpture changes abruptly, before the aperture has been reached, the bulky ribs, which are standing at great intervals, being replaced by very numerous and thin folds, some of them even dichotomous.

The siphonal area has nowhere been satisfactorily preserved.

Dimensions.—

Diameter of the shell	45 mm.
„ „ umbilicus	13 „
Height } of the last volution	18 „
Thickness } of the last volution	22 „

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Sutures.—Not known.

Locality, number of specimens examined.—E. of Guryul ravine, Khunmu, hor. **4**, 6-8-08, **1**.

KASHMIRITES sp. ind. aff. LÆVIGATO Waag.

(Pl. V, fig. 6.)

My materials for the determination of this species are, unfortunately, too unsatisfactory to justify the introduction of a proper specific name, although the Salt Range species, to which it could be closely compared, has been founded on even more scanty materials by Waagen.

The only specimen at my disposal consists of a fragment of the last whorl, comprising about three-quarters of the entire volution, with an impression of the inner coils adhering to it. It agrees very nearly with *Kashmirites lævigatus* Waagen (Salt Range Foss., *l.c.*, Vol. II, Fossils from the Ceratite formation, p. 86, Pl. VII, fig. 3) from the Ceratite sandstone of Chitta Wan.

Its transverse section is of equal height and width, and rounded all over, although its outlines are not curved regularly, but rather square-shaped, with broadly rounded angles. There is neither a distinct siphonal nor umbilical margin developed. Greatest transverse diameter corresponding to the middle of the height.

Ornamentation very delicate, consisting of numerous radial ribs, which originate in the umbilical region and cross the siphonal area, without being interrupted.

Dimensions.—Diameter of the shell		49 mm.
„ „ umbilicus		17 „
Height	of the last volution	19 „
Thickness	of the last volution	19 „

Sutures.—Siphonal lobe broad and short, with indistinct denticulations. The state of weathering of the cast does not allow of certainty as regards this character. Principal lateral lobe considerably deeper and serrated. Siphonal and principal lateral saddles of nearly equal height, with tops broadly rounded. Second lateral saddle low, followed by a small auxiliary lobe and saddle.

Locality, number of specimens examined.—E. of Guryul ravine, Khunmu, hor. **1**, 6-8-08, **1**.

Gen. STEPHANITES Waagen.

STEPHANITES sp. ind. aff. SUPERBO Waag.

(Pl. V, fig. 4.)

I should not have ventured on a determination of the single fragment available for examination without a beautiful plaster-cast of Waagen's type-specimen

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of *Stephanites superbus* (Salt Range Foss., *Pal. Ind.*, ser. XIII, Vol. II, Ceratite formation, p. 101, Pl. II, fig. 1) from Chidru at hand for comparison. My fragment consists of one-quarter of the last volution, belonging to the body-chamber, and the adjoining portion of the penultimate whorl. It shows a very close resemblance to the type of *Stephanites superbus*, if a corresponding portion from the commencement of the last whorl is taken into comparison. The only difference consists in the greater width of the transverse section of my specimen from Kashmir. Its whorls are, consequently, inflated yet more strongly, and its funnel-shaped umbilicus is proportionately deeper.

Siphonal area broadly and regularly rounded, passing into the lateral parts without any distinct demarcation. Flanks flattened, sloping steeply to the umbilical suture. Cross-section of rhomboidal outlines, recalling the transverse section in middle-sized individuals of *Durgaites Dieneri* Mojs. (Diener, Himal. Foss., *l.c.*, Vol. V, Pt. 2, Fauna of the Himalayan Muschelkalk, Pl. XI, fig. 2*d*).

The umbilical suture, separating the last and penultimate whorls, corresponds exactly with the siphonal margin in the latter. Along this margin four high and prominent spines are arranged, whose external slopes are hidden by the last volution. In the fragment of the last whorl two tubercles only of very large size correspond to four spines in the inner whorl. Their points have been partly broken off.

The shelly test, which has been partly preserved, is crossed by numerous and delicate striæ of growth, which in general keep a radial direction.

Reliable measurements could not be obtained, excepting the cross-section, where a height of 20 mm. corresponds to a width of 42 mm.

Sutures.—Two serrated lobes and two entire saddles are exposed along the aperture of the penultimate whorl. They correspond to the lateral and umbilical lobes and saddles. From the emarginations of the septum in the aperture it is evident that only four lobes and three saddles altogether have been present, exactly as in *Stephanites superbus*, where the auxiliary lobe is rather indistinctly developed.

Locality, number of specimens examined.—E. of Guryul ravine, Khunmu, hor. **1**, 6-8-08, **1**.

Gen. Nannites Mojs.

Nannites nov. sp. ind. (?)

(Pl. III, fig. 10.)

It is with great reserve that this specimen is grouped provisionally with the genus *Nannites* Mojs., the sutures not being accessible to examination.

In the globose shell, with its rounded flanks and deep, open umbilicus, and in the presence of constrictions on the surface of the cast my specimen agrees with typical forms of *Nannites*. It differs specially from the congeneric forms

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from the Lower Trias of the Himalayas and of North America by its strongly inflated whorls, which are twice as broad as high.

The last volution is marked with three constrictions, which are deeply impressed. They are not visible on the external surface of the shell and must, consequently, correspond to the thickened laminæ in the interior of the shell, as in the genus *Arcestes*. I have convinced myself of this fact by observing a small piece of the shelly test covering exactly one of the constrictions. Its surface is perfectly smooth and does not show any trace of the deep constriction hidden below.

Dimensions.—Diameter of the shell		13 mm.
,, ,, umbilicus		2·5 ,,
Height	of the last volution	4·5 ,,
Thickness	of the last volution	9 ,,

Locality, number of specimens examined.—E. of Guryul ravine, Khunmu, hor. **1,** 6-8-08, **1.**

Sub-class : NAUTILOIDEA.

Gen. ORTHOCERAS Breyn.

ORTHOCERAS sp. ind.

Fragments of *Orthoceras*, consisting of air-chambers, are rather numerously represented in the Himalayan collection from the Ophiceras layer near Pastannah (hor. **1,** 5-9-09).

Some of them show a remarkable resemblance to *O. campanile* Mojs. (Cephalopoden Mediterran. Triasprovinz, *Abhandl. k. k. Geol. Reichsanst.*, X, p. **291,** Taf. XCIII, figs. **1—4, 11**), which is also known from the Himalayan Muschelkalk of Kumaon and Spiti. Transverse section circular, angle of emergency very small. Siphuncle central. Distance between two septa exactly one-half the diameter of the lower chamber. Thus the septa are situated still more closely to each other than in *O. campanile*.

Notwithstanding the large number of fragments available for examination, my materials did not justify the introduction of a proper specific designation.

Gen. GRYPOCERAS Hyatt.

GRYPOCERAS nov. sp. ind.

A large fragment of a Nautiloid shell, consisting of four air-chambers of the last whorl and of the inner nucleus, has the generic characters of *Grypoceras*, but differs from the Triassic species of that genus hitherto described by its very broad cross-section. In the air-chamber marking the posterior termination of the last whorl a height of 34 mm. corresponds to a width of 52 mm. Transverse section trapezoidal. Greatest transverse diameter coinciding with the umbilical

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margin. From this place the flanks converge in the shape of flat planes towards the siphonal area, which is flatly arched, somewhat depressed in the middle, and separated from the lateral parts by distinct marginal shoulders.

Involution considerable, the last volution overlapping the penultimate one to the extent of more than one-third of the height of the latter. Umbilicus narrow. From the small size of the inner nucleus it is evident that this species must have been provided with volutions increasing more rapidly in height and width than *Grypoceras Brahmanicum* Griesb. or even *G. Lilangense* Dien.

Siphuncle.—Sub-central.

Sutures.—Agreeing entirely with those of *G. Brahmanicum* Griesb. (Diener, Cephalopoda Lower Trias, *Pal. Ind.*, ser. XV, Himal. foss., Vol. II, Pt. 1, p. 11; Pl. I, fig. 1), but less distant.

Locality, number of specimens examined.—Found loose, Pastannah, hor. ×, **4-9-09, 1.**

Class : Lamellibranchiata.

Gen. Pseudomonotis Beyr.

Pseudomonotis (Claraia) Griesbachi Bittner.

(Pl. V, fig. 8.)

1899. *Pseudomonotis Griesbachi* Bittner, *Palæont. Ind.*, ser. XV. Himalayan Foss., Vol. III, Pt. 2, Trias Brachiopoda and Lamellibranchiata, p. 2, Pl. I, figs. 1—4.
1908. *P. Griesbachi* Mansuy, *Contribution à la Carte géologique de l'Indochine, Service des Mines, Hanoi-Haiphong*, Paléontologie, p. 63, Pl. XVI, figs. 4, 5.

This is by far the most common species among the bivalves of the Ophiceras layer in Kashmir. It is, however, worth mentioning that in the materials under description left valves predominate enormously, whereas right ones are of extremely rare occurrence.

The specimens examined agree very closely with the types from the Otoceras beds of the Shalshal cliff, which were described and illustrated by Bittner so carefully that there is very little to be added to his description.

My largest specimens are nearly equal in size to the type illustrated in fig. 4 of Bittner's memoir, but the majority of examples are considerably smaller. Their surface is conspicuous for the absence of any distinct sculpture, the concentric lines of growth being visible only by means of a lens and a radial ornamentation being entirely absent. But from this type there are many transitional shapes leading to a faint and irregular concentric sculpture, which is, however, always developed less strongly and regularly than in *Pseudomonotis aurita* Hauer.

Locality, number of specimens examined.—Pastannah, Ophiceras layer, **hor. 1, 5-9-09, 16.**

Remarks.—F. Frech (Leitfossilien der Werfener Schichten und Nachtræge, etc., Resultate der Wissenschaftl. Erforschung des Balatonsees, Bd. I, T. 1, *Palæontol. Anhang*, Taf. VI, fig. 5) gives the figure of two valves of *P. Gries-*

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bachi, collected from the Otoceras beds of the Shalshal cliff, the left valve being distinguished by the presence of some strongly marked radial ribs. Among the numerous examples of this species, which I have been able to examine, I have never seen a single specimen with this sculpture. Nor have any similar shapes been mentioned by Bittner.

PSEUDOMONOTIS (CLARAIA) AURITA Hauer.

(Pl. V, fig. 9.)

1850. *Posidonomya aurita* F. v. Hauer, Ueber die von Herrn Bergrat W. Fuchs in den Venetianer Alpen gesammelten Fossilien, *Denkschr. kais. Akad. Wiss. Wien*, II, p. 12, Taf. III, figs. 5, 7, non 6.
1895. *Pseudomonotis ovata* Salomon, Geologische und Palæontologische Studien ueber die Marmolata, *Palæontographica*, XLII, p. 80, Taf. IV, figs. 42, 43.
1896. *Posidonomya Haueri* Tommasi, La fauna del Trias inferiore nel versante meridionale delle Alpi, *Palæontogr. Ital.*, I, p. 52, Pl. III, fig. 10.
1900. *Pseudomonotis (Claraia) aurita* Bittner, Ueber *Pseudomonotis Telleri* und verwandte Arten der unteren Trias, *Jahrb. k. k. Geol. Reichsanst.*, L, p. 587, Taf. XXIV, figs. 10, 11, 12.
1908. *Pseudomonotis aurita* P. v. Wittenburg, Beiträge zur Kenntnis der Werfener Schichten Suedtirols, *Koken's Geol. u. Palæontol. Abhandl.*, N. F., Bd. VIII, p. 273, Taf. XXXVII, fig. 13; XXXVIII, fig. 1.
1909. *Pseudomonotis aurita* Frech, Die Leitfossilien der Werfener Schichten und Nachträge zur Fauna des Muschelkalkes, der Cassianer und Raibler Schichten sowie des Rhaet und des Dachsteinkalkes, Resultate der wissenschaftlichen Erforschung des Balatonsees, Bd. I. T. I, *Palæontologischer Anhang*, p. 19, Taf. VI, figs. 1, 3, 4.

A. Bittner in his description of *Pseudomonotis Griesbachi* (Himalayan Foss., *l.c.*, p. 5) hinted at the possibility of an association of this Himalayan species with a true Alpine form, "perhaps not separable from *Pseudomonotis ovata* (Schaur.) Salomon" in the neighbourhood of Kiunglung, S.W. of the Niti pass. This supposed association really exists, as is evident from an examination of my specimens of *Pseudomonotis* from the Ophiceras layer of Pastannah. There have been found among numerous examples of *P. Griesbachi* two left valves, which certainly belong to *P. aurita* Hau. (*ovata* Sal.).

It was demonstrated by Bittner in 1900 that *P. ovata* Sal. must be united with *P. aurita* Hau. The latter species had been frequently confused with several forms closely allied, until typical specimens were redescribed and figured by that author.

My two casts clearly exhibit the characters of ornamentation peculiar to *Pseudomonotis aurita:* low, but distinctly developed and regularly arranged concentric ridges, which are not combined with any radial sculpture as in *P. Clarai* Emmr. One of them is strongly oblique, a character, which is considerably less prominent in the illustrated example.

The anterior wing has not been preserved.

The presence of this Alpine species, one of the leading forms of the Seis beds, which does not range into the Campil or upper Werfen beds in Europe, is of great interest, not only for its geographical distribution, but also for stratigraphical comparison, this being the first Mediterranean species of undoubtedly Triassic age, hitherto known from the Ophiceras beds of India.

Locality, number of specimens examined.—Pastannah, Ophiceras layer, hor. **1**, 5-9-09, **2**.

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PSEUDOMONOTIS (CLARAIA) PAINKHANDANA Bittn.

(Pl. V, fig. 10.)

1899. *Pseudomonotis Painkhandana* Bittner, Himalayan Foss., *Palæontol. Ind.*, ser. XV, Vol. III, Pt. 2, Trias Brachiopoda and Lamellibranchiata, p. 5, Pl. I, fig. 5.

This species has been separated from *Pseudomonotis Griesbachi* by Bittner by reason of its narrow, less oblique and vertically elongated shape. Left valves of small size only were known to him.

Among the materials from the Ophiceras beds of Kashmir numerous specimens, agreeing exactly with Bittner's type in dimensions and outlines, occur together with examples of large size, which must be united specifically without reservation to the former. One of my largest examples has been illustrated in fig. 10. It is an enlarged copy of Bittner's type from the Otoceras bed of the Shalshal cliff. The ratio between height and length (breadth) is between 4 :3 and 5 :4. Beak strongly inflated and projecting beyond the hinge-line, which posteriorly is not quite three times as long as anteriorly.

Associated with this large-sized example, which agrees entirely with the typical shape of the species, several specimens have been found, which are less narrow and in which the ratio of height and length is only 10 : 9. Those specimens resemble *Pseudomonotis Griesbachi* much more closely and are a convincing proof of the near affinity existing between the two species. Left valves only are known to me.

Specimens of large size and less elongated vertically than typical examples of *P. Painkhandana* very closely resemble *P. decidens* Bittn. from the Hedenstrœmia beds of Painkhanda. The only character, which, in well preserved valves, may serve as a distinctive feature, is the more oblique shape of the latter species, which in this respect approaches *P. Griesbachi* more nearly than *P. Painkhandana.*

Locality, number of specimens examined.—Pastannah, Ophiceras layer, hor. 1, 5-9-09, 14.

PSEUDOMONOTIS (CLARAIA) DECIDENS Bittn.

(Pl. V, fig. 14.)

1899. *Pseudomonotis decidens* Bittner, Himalayan foss., *Palæontol. Ind.*, ser. XV, Vol. III, Pt. 2, Triassic Brachiopoda and Lamellibranchiata, p. 11, Pl. I, figs. 22—24.

Of this species left valves only were known to Bittner from the Hedenstrœmia beds of the Central Himalayas. I have succeeded in chiselling out a nearly complete specimen, consisting of both valves, which are firmly attached to each other. In the right valve the umbo and the small anterior ear have been broken off. This valve is curved very flatly, the inequivalve character being consequently as prominent in this species as in the majority of congeneric forms. As regards

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the left valve, I have nothing to add to Bittner's description. The irregularity in the beak, which has been noticed by that author in two of his examples, is clearly developed in one of my specimens only. In the other specimens the beak is either quite or almost regular.

Both valves exhibit a very indistinct ornamentation, consisting of concentric striæ of growth.

Locality, number of specimens examined.—E. of Guryul ravine, Khunmu, hor. **1,** 6-8-08, 5, hor. **2,** 6-8-08, 4. Mandakpal, hor. **4,** 14-8-08, 2.

Pseudomonotis (Eumorphotis) tenuistriata Bittner.

(Pl. V, fig. 11.)

1898. *Pseudomonotis tenuistriata* Bittner, Beiträge zur Palæontologie der triadischen Ablagerungen zentralasiatischer Hochgebirge, *Jahrb. k. k. Geol. Reichsanst.*, XLVIII, p. 711, Taf. XV, fig. 7.

Associated with the more abundant forms of the section *Claraia* there occur in the Ophiceras layer of Kashmir several examples of the section *Eumorphotis* Bittner (*Jahrb. k. k. Geol. Reichsanst.*, Bd. L, 1900, p. 566), which are related more or less closely to *Pseudomonotis Venetiana* Hauer.

One of the most characteristic species of this section is *P. tenuistriata* Bittner. It is distinguished by its very numerous and delicate ribs, which are all equidistant and of equal strength. In this peculiar pattern of ornamentation left valves of moderate size agree exactly with Bittner's type of *P. tenuistriata* from the Werfen beds of Ravnau (Bokhara).

From an Alpine species provided with a similar ornamentation, *P. Liepoldi* Bittner (*Jahrb. k. k. Geol. Reichsanst.*, Bd. L, p. 576, Taf. XXIII, fig. 4), they are at once distinguished by their approximately circular outlines and by the regular slope of the umbonal region towards both wings.

Locality, number of specimens examined.—Ophiceras layer, Pastannah, hor. **1,** 5-9-09, 2.

Pseudomonotis (Eumorphotis) multiformis Bittn.

(Pl. V, fig. 13.)

1899. *Pseudomonotis aff. Venetianæ* (Hauer) Bittner, Himalayan foss., *l.c.*, Vol. III, Pt. 2, Trias Brachiopoda and Lamellibranchiata, p. 6, Pl. I, fig. 8.
1899. *Pseudomonotis multiformis* Bittner, Versteinerungen aus den Triasablagerungen des Sued-Ussuri-Gebietes in der ostsibirischen Kuestenprovinz, *Mémoires Comité Géologique, St. Pétersbourg*, VII, No. 4, p. 10, Pl. II, figs. 11—22.

A left valve of *Pseudomonotis* agrees exactly with the specimen from the Otoceras beds of the Shalshal cliff, which has been compared to *P. Venetiana* v. Hauer and to *P. inæquicostata* Ben. by Bittner. In its ornamentation four systems of ribs can be distinguished, whose alteration is by no means distinguished by special regularity. The ribs are sharp, originating in the umbo, and increasing in strength in the direction towards the margin of the shell.

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A. Bittner in discussing the affinity of his Himalayan form with Alpine species of *Eumorphotis*, has laid special stress on the difficulty of a clear definition of the latter, especially of *P. Venetiana*, on account of their state of preservation and of the scarcity of the fossil materials. It would be of no use to repeat his arguments, which forbid a direct identification with either *P. Venetiana* or *inæquicostata*.

There is, however, a Siberian species, *P. multiformis* Bittner, from the Lower Trias of Vladivostok, from which it can scarcely be separated. The arrangement of the ribs is quite as irregular as in Bittner's type-specimen from Shamara, illustrated in fig. 20. Along the ventral margin we find the following disposition of ribs, according to four systems : **1, 4, 3, 2, 3, 4, 1, 4, 3, 2, 3, 2**, etc. The anterior wing is neither marked off from the umbonal region as sharply as in *P. inæquicostata*, nor vaulted, but flat, as in *P. multiformis*.

P. multiformis is also probably represented in the Werfen beds of Ravnau (Bokhara).

Locality, number of specimens examined.—Ophiceras layer, Pastannah, hor. **1, 5-9-09, 1.**

PSEUDOMONOTIS (EUMORPHOTIS) sp. ind. aff. AUSTRIACA Bittner.

(Pl. V, fig. **12.**)

Among the casts belonging to *Eumorphotis* Bittner, there are several left valves, which in the faint development of their ornamentation approach very nearly to some species of the group of *Pseudomonotis angulosa* Lepsius. They are of small size and have been preserved rather indifferently. One of them, however, deserves a special description on account of its near relationship to an Alpine species, *P. austriaca* Bittner (Ueber *Pseudomonotis Telleri* und verwandte Arten der unteren Trias, *Jahrb. k. k. Geol. Reichsanst.*, Bd. L, 1900, p. 572, Taf. XXII, fig. 9). With this species it agrees very closely in its dimensions, in the strongly inflated character of its umbonal region, in its oblique shape and in its sculpture. Beak projecting considerably beyond the hinge-line, with steep slopes, especially in the direction towards the anterior wing. This wing is separated from the remainder of the shell less distinctly than in *P. austriaca*. It has been partly injured, but seems to have been bordered by an emargination, as in the Alpine form. Posterior wing preserved in indistinct outlines only.

Ornamentation consisting of delicate concentric striæ of growth and of faint radial ribs, which are disposed irregularly and become obsolete, before reaching the margins of the valve.

Locality, number of specimens examined.—Ophiceras layer, Pastannah, hor. **1, 5-9-09, 1.**

Remarks.—*Pseudomonotis austriaca* is probably also represented in the Lower Trias of Vladivostok.

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II.—FOSSILS FROM THE MUSCHELKALK.

Class: CEPHALOPODA.

Sub-class: AMMONOIDEA.

Gen. CERATITES de Haan.

The group of *Ceratites nodosi* is rather richly represented in the Muschelkalk of Kashmir, but the group of *Ceratites circumplicati* (*Hollandites*) plays a less important part than in Spiti and Painkhanda. Of the rare sub-genus *Halilucites*, a single, fragmentary specimen has been noticed. The group of *Ceratites subrobusti* (*Keyserlingites*, *Durgaites*) is as yet unknown from the Lower Muschelkalk of Kashmir.

CERATITES THUILLERI Oppel.

(Pl. VII, figs. 2, 3.)

1863. *Ammonites Thuilleri* Oppel, *Palæontologische Mitteilungen aus dem Museum des kgl. Bayr. Staates*, Stuttgart, p. 277, Pl. 77, fig. 3.
1895. *Ceratites Thuilleri* Diener, Himal. Foss., *Palæontologia Indica*, ser. XV, Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 21, Pl. I, figs. 1, 2.
1907. *C. Thuilleri* Diener, *ibidem*, Vol. V, Pt. 2, Fauna of the Himalayan Muschelkalk, p. 46.
1911. *C. Thuilleri* Renz, Die mesozoischen Faunen Griechenlands, I. Teil. *Palæontographica*, Bd. LVIII, p. 35.

This is by far the commonest species of *Ceratites nodosi* in the collections from Kashmir. Some of the specimens before me are remarkable for their excellent state of preservation. Two types have been chosen for illustration, because they represent stages of growth which have not been figured in the memoirs quoted above.

One of them is the inner nucleus of a large specimen with the following measurements:—

Diameter of the shell		47 mm.
„ „ umbilicus		14·5 „
Height	of the last volution	19 „
Thickness	of the last volution	16·5 „

In this nucleus the proportion of height and thickness differs considerably from that which is known in later stages of growth. The sculpture is very coarse, but the proportion of lateral and marginal tubercles is not the same as in the majority of full-grown examples, intercalated ribs which are devoid of lateral tubercles occurring rather frequently.

The second specimen is the cast of a body-chamber, the largest which has come to my knowledge. In the aperture a height of 41·5 mm. corresponds to a width of 30 mm. The sculpture is exactly the same as in the body-chamber of Oppel's type-specimen. The dichotomy of the ribs, so common in earlier stages of

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growth, has been replaced entirely by intercalation of secondary costæ. Lateral and marginal tubercles persist throughout the last volution, but the umbilical tubercles gradually become obsolete.

The specimens from the Muschelkalk of Kashmir exhibit as great a variability in size and ornamentation as the examples from Spiti. Two varieties have been noticed particularly, one with coarser and a second one with more delicate ribs. It is the latter to which Oppel's type belongs. The nucleus illustrated in this memoir is a good instance of the first variety.

Locality, number of specimens examined.—Ptychites layer, Spur N.N.E. of Khunmu, Vihi district, hor. **7,** 11-8-08, 1; Ptychites layer, E. of Guryul ravine, Khunmu, hor. **7,** 11-8-08, 2; Upper Gymnites layer, Temple hill, Khrew, hor. **1,** 17-9-09, 1; Lower Gymnites layer, Pastannah, hor. **1,** 27-8-09, 5; Lam, Patarkul valley, hor. **3¾,** 16-8-09, 1; Gymnites layer, Khrew, hor. **2,** 17-9-09, 3; Upper Gymnites layer, Pastannah, hor. **2,** 27-8-09, 1.

CERATITES cf. TRINODOSUS Mojs.

1882. *Ceratites trinodosus* E. v. Mojsisovics, Die Cephalopoden der Mediterranen Triasprovinz, *Abhandl. k. k. Geol. Reichsanst.*, p. 29, Taf. VIII, figs. 5, 6, 7, 9; XXXVIII, figs. 6, 7.
1907. *C. trinodosus* Diener, Himal. Foss., *Palæont. Indica*, ser. XV, Vol. V, Pt. 2, Fauna of the Himalayan Muschelkalk, p. 48, Pl. III, fig. 5. A complete list of synonyms is found in this memoir.

A single, fragmentary specimen from the Ptychites layer of the ridge N. 15° W. of Khrew, Vihi district, hor. **2,** 16-9-09, probably belongs to this species, not to *Ceratites Thuilleri* Oppel. The number of marginal tubercles is 18, corresponding to 9 lateral and umbilical ones. The most important character of distinction between *C. trinodosus* and *C. Thuilleri*, the mode of involution, cannot be made out, unfortunately, the inner whorls not being accessible to examination in the present cast. But from the small diameter of the umbilicus, 9 mm., corresponding to a diameter of the entire shell of 45 mm., it might be suggested that the involution takes place inside, not outside, the spiral line of lateral tubercles.

The characters of our specimen, as far as known, are therefore in favour of an identification with *C. trinodosus*, although it does not allow of accurate determination.

CERATITES sp. ind. aff. THUILLERI Oppel.

(Pl. VII, fig. 3.)

The single specimen available for examination, one side of which has been preserved only, has distinctly elliptical outlines, but there is no reason for attributing this character to later distortion by pressure in the rocks. A little less than one-half volution belongs to the body-chamber.

This specimen offers many affinities with *Ceratites Thuilleri* Oppel, both in general shape and sculpture. As in that species, the involution takes place out-

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side the spiral line along which the lateral tubercles are arranged, not inside, as in *C. trinodosus* Mojs. and in *C. Himalayanus* Blanf. The ventral area is broad, gently arched, not carinate.

The chief difference between the present species and *C. Thuilleri* consists in the faint development of the sculpture, and in the character of the lateral ribs, which are sharper and narrower than in *C. Thuilleri*. These sharp and narrow ribs have been noticed at the commencement of the last volution only. They are replaced by flatly rounded indistinct ridges in the penultimate whorl. The lateral tubercles, however, are marked very strongly both in the penultimate whorl and in the chambered portion of the last one, but become obsolete in the body-chamber.

Dichotomy and intercalation of ribs are noticed as frequently as in *C. Thuilleri*.

Sutures.—Agreeing with those in *C. Thuilleri*.

Dimensions.—Diameter of the shell		93 mm.
,, ,, umbilicus		30 ,,
Height	of the last volution	37 ,,
Thickness	of the last volution	23 ,,

Locality, number of specimens examined.—Lam, Patarkul valley, hor. **3**$\frac{4}{5}$, **16-8-09, 1.**

Ceratites Kuvera Diener.

(Pl. VII, fig. 4.)

1895. *Ceratites Kuvera* Diener, Himalayan Foss., *Palæont. Ind.*, ser. XV, Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 25, Pl. V, fig. 2.

1907. *C. Kuvera* Diener, *l.c.*, Vol. V, Pt. 2, The Fauna of the Himalayan Muschelkalk, p. 57, Pl. IV, fig. 5.

The specimen figured agrees with the variety of *Ceratites Kuvera*, which has been described in my second memoir, in the presence of a high and steep umbilical wall, of a roof-shaped siphonal area, of a wide and open umbilicus, and in the absence of umbilical tubercles. In the bulky character of the ribs and in the development of stout marginal tubercles our specimen differs decidedly from *C. Thuilleri* Opp.

In its dimensions the specimen from Kashmir agrees very closely with the variety from Kalapani, Byans, the measurements of which have been given in the memoir quoted above.

Dimensions.—Diameter of the shell		65 mm.
,, ,, umbilicus		22 ,,
Height	of the last volution	26·5 ,,
Thickness	of the last volution	22 ,,

Locality, number of specimens examined.—Ptychites layer, E. of Guryul ravine, Khunmu, hor. **7, 11-8-08, 1.**

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CERATITES sp. ind. aff. BINODOSO Hauer.

(Pl. VIII, fig. 4.)

A body-chamber fragment, comprising one-half volution, is of special interest on account of its sculpture, which reminds me very strongly of the Alpine *Ceratites binodosus* v. Hauer (*Denkschr. kais. Akad. Wiss.*, 1850, Bd. II, p. 114, Taf. XIX, figs. 1, 4), and also of some species from the German Muschelkalk.

I shall begin with a morphological description of this interesting form and discuss its affinities afterwards.

Unfortunately, of the inner whorls only very little is known to me. A portion of the penultimate whorl adhering to the body-chamber has a smooth sculpture, with faint traces of lateral tubercles. The principal elements in the ornamentation of the body-chamber are lateral and marginal thorns, not the ribs. The ribs are few in number, straight, not falciform, and as a rule not dichotomous. Augmentation of ribs by intercalation is quite an exception. The number of marginal thorns is twice the number of lateral ones. Both of them are of nearly equal strength and height. Five lateral and ten marginal thorns are counted within the circumference of the fragment described.

The transverse section is moderately high, with lateral parts flatly arched. The greatest transverse diameter corresponds with the lateral thorns. Umbilical wall high, vertical, passing abruptly into the flanks. Siphonal area flatly vaulted and limited off sharply from the marginal region.

It is impossible to mistake this fragment for the body-chamber of a large example of *Ceratites Thuilleri* Opp. It only needs a glance at specimens of *C. Thuilleri* of equal size to see the difference, which consists chiefly in the distance of the ribs, which are standing much wider apart. Among the Himalayan *Ceratites* the present species appears to be related more nearly to *C. Royleanus* Diener (Fauna of the Himalayan Muschelkalk, Himalayan Foss., *l.c.*, Vol. V, Pt. 2, p. 52; Pl. IV, fig. 1). With this Indian species it agrees in the small number of ribs and in the predominence of spines, but in *C. Royleanus* the ornamentation is developed much more faintly and the transverse section is lower.

Among the German representatives of the section of *Nodosi*, *Ceratites atavus* Philippi (Die Ceratiten des oberen Deutschen Muschelkalkes, *Palæontologische Abhandl. von Dames u. Koken*, VIII, 1901, p. 49, Taf. XXXIV, figs. 1—4) and *C. sp. ind.* Philippi (*ibid.*, Taf. XXXIX, fig. 4) recall our species in their external characters. But both of them are of much smaller size and there is no argument in favour of any real affinity between the German and Indian forms.

If the sculpture of the inner whorls, as far as preserved, could be proved to be original and not produced by weathering, it might lead us to the suggestion that this species is rather primitive in its characters of ornamentation. Provided the inner whorls were really devoid of sculpture, they might correspond to the smooth inner volutions of the majority of *Ceratites*. Then the body-chamber

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might represent the stage of dichotomous sculpture so common in the inner whorls of *Ceratites nodosi.*

Locality, number of specimens examined.—Lam, Patarkul valley, hor. **3¾**, 16-8-09. **1.**

CERATITES TRUNCUS Oppel.

(Pl. VIII, fig. 5.)

1865. *Ammonites truncus* Oppel, *Palæontologische Mitteilungen aus dem Museum des kgl. Bayr. Staates*, Stuttgart, p. 292, Pl. 86, fig. 3.
1895. *Ceratites truncus* Diener, Himal. Foss., *Pal. Ind.*, ser. XV, Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 26, Pl. I, fig. 7.
1907. *C. truncus* Diener, *ibid.*, Vol. V, Pt. 2, Fauna of the Himalayan Muschelkalk, p. 53, Pl. IV, figs. 2, 3.

This species is represented in the Himalayan collection both by inner nuclei and by body-chamber fragments, but an identification of isolated fragments of outer volutions cannot be recommended, on account of their close resemblance to *C. Devasena* Dien. and *C. Vyasa* Dien.

The inner nucleus illustrated in fig. 5 agrees very closely with the type of *C. truncus* figured in Pl. IV, fig. 4, of my memoir on the fauna of the Himalayan Muschelkalk. It is provided with very stout and prominent marginal tubercles which persist throughout the entire circumference, corresponding to a diameter of 52 mm. The lateral tubercles are of knob-like shape and mark as a rule the places, where the single ribs bifurcate. They are situated in the middle of the flanks and separated from the row of marginal thorns by a distinct zone of depression affecting the general height of the ribs. In this character the sculpture of our specimen agrees exactly with that noticed in the type from Muth, Spiti. Umbilical tubercles are entirely absent.

Dimensions.—Diameter of the shell		52 mm.
„ „ umbilicus		14 „
Height	of the last volution	22·5 „
Thickness	of the last volution	19 „

Locality, number of specimens examined.—Upper Gymnites layer, Pastannah, hor. **1,** 27-8-08, **1.**

CERATITES ONUSTUS Oppel.

(Pl. VIII, fig. 2.)

1863. *Ammonites onustus* Oppel, *Palæontologische Mitteilungen aus dem Museum des kgl. Bayr. Staates*, Stuttgart, Pl. LXXVII, fig. 2, p. 277.
1865. *Ammonites Blanfordi* Salter, *Palæontology of Niti*, Calcutta, p. 66, Pl. VI, fig. 2.
1895. *Ceratites onustus* Diener, Himalayan Foss., *Palæont. Ind.*, ser. XV, Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 18, Pl. I, fig. 5.

Oppel's type-specimen of *Ceratites onustus* from Kuling, Spiti, is the fragment of a chambered whorl, which consists of nearly one-half volution. Stoliczka (*Mem. Geol. Survey of India*, Vol. V, Pt. 1, p. 57) was perfectly right in remarking that fragments like this are not worthy of specific names.

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In the Himalayan collection an example has been noticed, the outer whorl of which agrees with Oppel's type-specimen both in ornamentation and sutures.

It is certainly different from all species of *Ceratites nodosi* hitherto described. In order to retain Oppel's name I have made use of it for this specimen, although a direct identification of any species with a fragment as poorly preserved as Oppel's type-specimen is rather risky.

The outer volution of the present specimen is a fragment consisting of four air-chambers only. But the inner nucleus attaining a diameter of 55 mm., has been preserved entirely. It differs remarkably from equally-sized examples of *C. truncus* and *C. Devasena*, although it undoubtedly belongs to the group of *C. nodosi.*

The sculpture is less bulky than in *C. truncus*, but much more so than in *C. trinodosus* Mojs. or in *C. Thuilleri* Opp. The ribs do not bifurcate in the stout lateral tubercles as regularly as in *C. truncus.* But the most important difference is the faint development of marginal tubercles which lose their knob-like shape and become gradually obsolete at early stages of growth, before even a diameter of 40 mm. has been reached. In the meantime the transverse section, which is trapezoidal in the inner volutions, gradually assumes a more elliptical shape.

The involution takes place outside the spiral row of lateral tubercles.

From inner nuclei of *C. Devasena* the present form is at once distinguished by its less compressed shape, its more prominent sculpture, and by the absence of umbilical tubercles.

The fragment of the outer volution is broadly elliptical in section and provided with simple, straight ribs which are acute and turned slightly forward in the vicinity of the siphonal margin. They are less prominent than in *C. Devasena* and in *C. Vyasa.*

Dimensions.—Diameter of the shell		55 mm.
,, ,, umbilicus		17 ,,
Height	of the last volution	25 ,,
Thickness	of the last volution	20 ,,

Sutures.—Agreeing exactly with those in Oppel's type-specimen of *C. onustus.*

Locality, number of specimens examined.—Upper Gymnites layer, Temple hill, Khrew, Vihi district, hor. **2,** 17-9-09, 1.

CERATITES sp. ind. aff. SUPERBO Mojs.

(Pl. VIII, fig. **1.**)

Two specimens are, unfortunately, not sufficiently well preserved, to admit of specific determination, but are certainly very closely allied to *Ceratites superbus*

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v. Mojsisovics (Cephalopoden der Mediterranen Triasprovinz, *Abhandl. k. k. Geol. Reichsanst.*, Bd. X, p. 32, Taf. XXVIII, fig. 10, XXXIII, figs. 5, 6).

The more complete specimen from the Ptychites bed E. of Guryul ravine, Khunmu, hor. **7,** 11-8-08, is provided with its body-chamber. Three-quarters of the last volution are fairly well preserved, but the umbilical region has partly suffered from weathering and the inner whorls have been destroyed entirely.

The most remarkable character is the contrast in the sculpture of the lower and upper parts of the flanks. The lower zone, measuring about one-third of the entire height of the whorl, is almost smooth, faint traces of radial ribs only being occasionally indicated. The umbilical edge is adorned with moderately strong tubercles, the number of which, however, cannot be made out with certainty. It is undoubtedly inferior to the number of lateral tubercles, although the difference is not so remarkable as in the Alpine *C. superbus.*

The outer zone of the flanks is covered with numerous ribs, which are not quite straight, but slightly falciform. They are cut off along the border of the smooth inner zone, but do not swell regularly into lateral tubercles. Exceptionally, two ribs diverge from one lateral tubercle, but as a rule the ribs are simple, not dichotomous. Such ribs as do not originate in lateral tubercles, must therefore be considered as being intercalated. Both the principal and intercalated ribs meet the siphonal area in marginal tubercles, 22 of which are counted in one-half volution.

The transverse section of the aperture agrees closely with that noticed in *C. superbus*, but the siphonal area is a little narrower, the greatest transverse diameter corresponding exactly with the zone of lateral tubercles. The transverse section is, however, not lanceolate, as in *C. superbiformis* Diener (Himalayan Foss., Vol. V, Pt. 2, The fauna of the Himalayan Muschelkalk, p. 50, Pl. III, fig. 4), any trace of a siphonal keel being entirely absent, even at the beginning of the last volution.

In my second specimen from the bed with *Rhynchonella trinodosi* (hor. **3,** 15-9-09) in the section of the ridge N.N.W. of Khrew, Vihi district, one-half of the body-chamber whorl and the outlines of the impression of the entire shell in the matrix have been preserved. The umbilical margin having been destroyed entirely, the proportion of umbilical and lateral tubercles cannot be stated. In this specimen also a considerable number of intercalated ribs are noticed, which are free from any lateral tubercles. The difference in the number of lateral and marginal tubercles appears therefore to be a good character distinguishing this species from both the Alpine *C. superbus* Mojs. and the Indian *C. superbiformis* Dien.

Dimensions.—Diameter of the shell		71 mm.
,, ,, umbilicus		19 ,,
Height of the last volution	above the umbilical suture	30 ,,
	,, ,, preceding whorl	25 ,,
Thickness of the last volution		17 ,,

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CERATITES sp. ind. aff. FALCIFER Hauer.

(Pl. VII, fig. 1.)

Of this interesting species one single, imperfect specimen has been found loose below the hor. **4,** 15-9-09 (*Rhynchonella* beds) of the Temple hill near Khrew, Vihi district. A considerable part of the inner volutions and the outer half of the body-chamber whorl have been preserved.

At a first glance the specimen recalls *Ceratites* (*Hollandites*) *Ravana* Dien., on account of its ornamentation, but the transverse section shows the outlines typical in a representative of the group of *C. nodosi.* Its siphonal area is broad, flatly vaulted and distinctly limited off from the marginal region of the flanks. It differs considerably from the transverse section of *Hollandites Ravana*, which is provided with a narrow and sharply rounded siphonal part, passing gradually into the lateral parts.

The ornamentation of the body-chamber consists of numerous, tolerably flat, broad ribs, which rise from stout, indistinctly defined tubercles near the umbilical margin. The ribs are falciform and bifurcate, when rising from the umbilical elevations. Between the principal ones secondary ribs are intercalated in the upper portions of the lateral parts. This is exactly the sculpture as noticed in the body-chamber of *H. Ravana*, with the one exception, however, that in the specimen illustrated all the ribs swell out into distinct tubercles along the siphonal margin, which is not the case in *H. Ravana.* Well-defined marginal tubercles are noticed in *H. Airavata* Dien., but in this species the ornamentation is altogether more delicate and the umbilical tubercles far exceed the marginal ones in strength, which is not the case in the present specimen.

The penultimate whorl shows a very coarse sculpture, recalling more strongly the ornamentation of the inner nuclei of *Ceratites s. s.* than of *Hollandites.* Bulky primary ribs, which originate from faintly marked umbilical tubercles, alternate very regularly with intercalated ones. There is no bifurcation noticed in the umbilical region. The ribs are not distinctly falciform but a sort of geniculation coincides with the zone of marginal tubercles.

There is one species from the Alpine Muschelkalk, to which the present one seems to be more nearly allied than to the Indian representatives of the genus. This is *Ceratites falcifer* v. Hauer (Beitræge zur Kenntnis der Cephalopoden aus der Trias von Bosnien, II, Nautileen und Ammoniten mit ceratitischen Loben aus dem Muschelkalk von Haliluci bei Sarajevo, *Denkschr. kais. Akad. Wissensch.*, 1895, Bd. LXIII, p. 258, Taf. VIII, figs. 5, 6). This species agrees very closely with our Himalayan type, both in its trapezoidal transverse section and in its sculpture, which is especially remarkable for the development of numerous falci-

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form ribs with marginal tubercles. A comparison of the inner nuclei is, unfortunately, impossible, the inner volutions of the Alpine form not being known.

Dimensions.—Diameter of the shell	66·5	mm.
,, ,, umbilicus	15	,,
Height } of the last volution	31	,,
Thickness } of the last volution	20	,,

Sutures.—Not known.

Ceratites (Hollandites) Voiti Oppel.

1860. *Ammonites Voiti* Oppel, *Paläontologische Mitteilungen aus dem Museum des kgl. Bayr. Staates*, Stuttgart, I, p. 267, Taf. LXXVII, fig. 1.

1895. *Ceratites Voiti* Diener, Himal. Foss., *Paläont. Ind.*, ser. XV, Vol. II, Pt. 2. Cephalopoda of the Muschelkalk, p. 8, Pl. II, figs. 1, 2.

1907. *C. Voiti* Diener, *ibidem*, Vol. V, Pt. 2, Fauna of the Himalayan Muschelkalk, p. 60, Pl. VII, figs. 3, 4.

The majority of specimens from Kashmir may be considered as transitional shapes between *Hollandites Voiti* Opp. and *H. Ravana* Dien. The ornamentation is as a rule denser than in typical examples of *H. Voiti*. Bifurcation of ribs does not occur very frequently, and true lateral tubercles are but rarely noticed.

There is only one specimen which, in my opinion, should be attributed to *H. Voiti s. s.* without any reserve. This is a large, completely chambered example, consisting of a little less than one-half volution and of the inner whorls. In the aperture of the outer whorl a height of 46 mm. corresponds to a width of 32 mm. The complete specimen must therefore have been even larger than Oppel's type. The sculpture of the inner nucleus agrees exactly with that illustrated in Pl. VII, fig. 3, of my memoir on the fauna of the Himalayan Muschelkalk.

Locality, number of specimens examined.—Lower Gymnites layer, Pastannah, hor. **1**, 27-8-09, 1

Ceratites (Hollandites) Ravana Dien.

1895. *Ceratites Ravana* Diener, Himalayan Foss., *Paläont. Ind.*, ser. XV, Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, pp. 10—12, Pl. I, figs. 3—6.

1907. *Hollandites Ravana* Diener, *ibidem*, Vol. V, Pt. 2, Fauna of the Himalayan Muschelkalk, p. 62, Pl. IV, fig. 7.

I have united the transitional forms between *Hollandites Voiti* and *H. Ravana* from the Muschelkalk of Kashmir with the latter species, because the large number of falciform ribs and the insignificant number of tubercles are rather in favour of an identification with *H. Ravana*.

Two specimens are distinguished from the typical shape of *H. Ravana* by the presence of indistinct tubercles along the marginal region of the flanks. In this character they agree with my type-specimen of *H. Airavata* from the Muschelkalk of the Shalshal cliff, but the absence of strongly marked umbilical tubercles and the coarse ornamentation forbid their identification with *H. Airavata*. In

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the latter species only such examples of the group of *H. Ravana* should be included as are distinguished by a very delicate sculpture in adult stages and in which the umbilical tubercles are more prominent than the lateral ribs.

I consequently prefer to consider the two specimens in question as a variety of *H. Ravana.*

Locality, number of specimens examined.—Lower Gymnites layer, Pastannah, hor. **1,** 27-8-09, **11**; hor. **3,** 3-9-09, **1.** Upper Gymnites layer, Pastannah, hor. **2,** 27-8-09, 1. Upper Gymnites layer, 1 mile W. of Pastannah, hor. **1,** 8-9-09, **1.**

CERATITES (HOLLANDITES) DUNGARA Diener.

1895. *Ceratites Dungara* Diener, Himalayan Foss., *Palæont. Ind.*, ser. XV, Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 15, Pl. II, fig. 2.

1907. *Hollandites Dungara* Diener, *ibidem*, Vol. V, Pt. 2, Fauna of the Himalayan Muschelkalk, p. 65.

Of this species a single, fairly well preserved specimen has been found in the Himalayan collection. It is remarkable on account of the large diameter of its umbilicus and the small height of its last volution. Although this volution is completely chambered, it barely increases in height throughout one-half of its circumference. In the meantime a distinct egression of the umbilical suture is noticed, which leaves the normal spiral. I do not know of any other species of *Hollandites*, in which this character is marked as strongly as in the type of *H. Dungara* from Kuling.

In its sculpture this example marks a shape intermediate between *H. Dungara* and *H. Voiti*, the ribs being less sharp and elevated less strongly in the middle region of the lateral parts than in the type-specimen of *H. Dungara.*

Dimensions.—Diameter of the shell	85 mm.
,, ,, umbilicus	27 ,,
Height of the last volution	32 ,,
,, ,, penultimate whorl	20 ,,
Thickness of the last volution	25 ,,

Locality, number of specimens examined.—Lower Gymnites layer, Pastannah, hor. **1,** 27-8-09, **1.**

CERATITES (HOLLANDITES) cf. ARJUNA Dien.

1895. *Ceratites Arjuna* Diener, Himalayan Foss., *Palæont. Ind.*, ser. XV, Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 17, Pl. IV, fig. 1.

The fragment of an outer volution, containing a large part of the body-chamber, exhibits the beautiful sculpture characteristic of *Hollandites Arjuna.* The gently curved radial ribs slope more gently towards the aperture than to the reverse side, and do not swell out into distinct tubercles, although they reach their greatest height in the middle of the lateral parts.

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The sutural line is remarkable for the large size of the principal lateral saddle, for its brachyphyllic saddles which are serrated up to the last entire arch, and for the presence of a very large and broad auxiliary or umbilical lobe, which is situated on almost the same level as the second lateral lobe. In all those characters the present specimen agrees exactly with the type of *H. Arjuna*. A provisional identification seems therefore to be justified, notwithstanding its fragmentary state of preservation.

Locality, number of specimens examined.—Lower Gymnites layer, Pastannah, hor. **1,** 27-8-09, 1.

Ceratites (Hollandites) Vyasa Diener.

1895. *Ceratites Vyasa* Diener, Himalayan Foss., *Palæontologia Ind.*, Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 19, Pl. VI, fig. 2.
1907. *Hollandites Vyasa* Diener, *ibidem*, Vol. V, Pt. 2, Fauna of the Himalayan Muschelkalk, p. 66, Pl. VII, figs. 1, 2.

This species is represented by two determinable examples in the Himalayan collection. One of them is a chambered nucleus, attaining a diameter of 76 mm. It agrees exactly with the nucleus of *Holl. Vyasa*, illustrated in Pl. VII, fig. 2, of my second memoir quoted above. The absence of tubercles in its ornamentation distinguishes it at once from all representatives of the group of *Ceratites nodosi*. All the ribs are broadly rounded and very irregular in strength. The transverse section is nearly elliptical, with a narrow siphonal area, which is highly rounded and passes gradually into the lateral parts.

The second specimen is a fragmentary inner nucleus, provided with part of the outer volution, which contains the commencement of the body-chamber. The sculpture of the outer volution agrees exactly with that in *Holl. Derasena* and *H. Vyasa*, as illustrated in my memoir quoted above.

Locality, number of specimens examined.—Lower Gymnites layer, Pastannah, hor. **1,** 27-8-09, 1. Upper Gymnites layer, 1 mile W. of Pastannah, hor. **1,** 8-9-09, 1.

Ceratites (Hollandites) sp. ind. ex aff. Cecilii Dien.

This species, which is unfortunately represented by a single fragmentary specimen, has close affinities both with *Hollandites Nalikanta* Diener (Himalayan Foss., *l.c.*, Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 45, Pl. IX, figs. 5—7) and *H. Cecilii* Diener (*ibidem*, Vol. V, Pt. 2, Fauna of the Himalayan Muschelkalk, p. 67, Pl. III, fig. 6; VII, fig. 6).

It agrees with *H. Nalikanta* in its ornamentation, which consists of faintly marked falciform folds, but differs from it by its wider umbilicus and its larger size. In these two characters it agrees more closely with *H. Cecilii*, from which, however, it is distinguished by its more prominent sculpture, the body-chamber whorl of equally-sized examples of *H. Cecilii* being almost quite smooth. In its

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dimensions this fragment agrees pretty well with the type-specimen of *H. Cecilii*, illustrated in Pl. VII, fig. 6, of my memoir on the fauna of the Himalayan Muschelkalk.

Locality, number of specimens examined.—Lower Gymnites layer, Pastannah, hor. **1,** 27-8-09, 1.

CERATITES (HALILUCITES) sp. ind.

The group of *Ceratites rusticus* Hauer (sub-genus *Halilucites*) is represented in the Himalayan collection by a single fragment of an outer volution consisting of four air-chambers only. Although the presence of a rounded keel bordered by deep marginal furrows proves the correctness of including this specimen with *Halilucites* Dien., it is not possible to arrive at a specific identification, on account of its imperfect state of preservation.

It is probably allied to *Halilucites planilateratus* v. Hauer (Beitræge zur Kenntnis der Cephalopoden aus der Trias von Bosnien, II, *Denkschr. kais. Akad. Wissensch.*, Bd. LXIII, p. 261, Taf. XI, figs. 1—3), and to the species from the Shalshal cliff which has been described in my memoir on the fauna of the Himalayan Muschelkalk (*Palæont. Ind.*, ser. XV, Vol. V, Pt. 2, p. 59, Pl. V, fig. 3), but differs from them by the development of distinct lateral tubercles which are situated below the middle of the flanks and correspond with occasional bifurcations of the primary ribs. Otherwise the sculpture recalls that noticed in the Himalayan form from the Shalshal cliff, especially in the presence of marginal bumps and sharp, forward turned geniculations in the lateral ribs along the siphonal margin.

Locality, number of specimens examined.—Top bed of lower Gymnites layer, Pastannah, hor. **1,** 27-8-09, 1.

Gen. BEYRICHITES Waagen.

BEYRICHITES KHANIKOFI Oppel.

1865. *Ammonites Khanikofi* Oppel, *Palæontologische Mitteilungen aus dem Museum des kgl. Bayr. Staates*, Stuttgart, I, p. 275, Taf. LXXVI, fig. 4.
1895. *Meekoceras Khanikofi* Diener, Himal. Foss., *Palæont. Ind.*, ser. XV, Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 41, Pl. VIII, fig. 3; IX, figs. 1, 2, 3, 9.
1907. *Beyrichites Khanikofi* Diener, *ibidem*, Vol. V, Pt. 2, Fauna of the Himalayan Muschelkalk, p. 82.

Of this characteristic species of the Himalayan Muschelkalk specimens have been met with in the materials collected by C. S. Middlemiss from the following localities and horizons: Gymnites layer, Khrew, hor. **2,** 17-9-09, 2; Lower Gymnites layer, Pastannah, hor. **3,** 3-9-09, 10; hor. **1,** 27-8-09, 2.

The majority of specimens are of small size and badly preserved, but the characters accessible to observation are sufficiently well marked to warrant identification.

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Beyrichites Kesava Diener.

1895. *Meekoceras Kesava* Diener, Himal. Foss., *Palæont. Ind.*, ser. XV, Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 43, Pl. VIII, fig. 6.
1907. *Beyrichites Kesava* Diener, *ibid.*, Vol. V, Pt. 2, Fauna of the Himalayan Muschelkalk, p. 83.

A well preserved specimen attaining a diameter of 45 mm. apparently belongs to this species, which is distinguished from *Beyrichites Khanikoft* Opp. by the shape of its umbilicus. This is very deep, bordered by vertical walls and does not show any disjunction of the spiral line. Where the sutures have been completely preserved the saddles are serrated up to their very tops.

Locality, number of specimens examined.—Lower Gymnites layer, Pastannah, hor. **3,** 3-9-09, **1.**

Gen. Hungarites Mojs.

This genus which had, as yet, not been noticed in the Himalayan Muschelkalk, is represented in the collections from Kashmir, although very rarely and by fragmentary specimens only, which do not permit of a specific identification. I am bound to agree with Tornquist (*Zeitschr. Deutsche Geol. Ges.*, 1898, Bd. L, p. 654) in considering the determination of species belonging to the genus *Hungarites* a very difficult task, even with better materials at hand than those available for examination.

Hungarites sp. ind.

(Pl. VII, figs. 5, 6.)

The three fragmentary specimens before me belong to one single species, which must certainly be included in the genus *Hungarites* Mojs., on account of their roof-shaped siphonal area. This is raised into a high and acute median edge and bordered by obtuse marginal edges.

My specimens are fragments of outer whorls, consisting of a part of the body-chamber with the last air-chambers adhering to it. The transverse section is high and very strongly compressed. The greatest transverse diameter is situated below the middle of the height of the lateral parts. From this place the flanks slope in a gentle curve both towards the marginal and umbilical edges. The low umbilical wall is vertical and sharply separated from the lateral parts.

In its ornamentation this Indian species to a certain extent recalls the fragmentary specimens from Mora d'Ebro which have been illustrated by E. v. Mojsisovics in Pl. XXXIII, figs. 1, 2, of his memoir "Cephalopoden der Mediterranen Triasprovinz" (*Abhandl. k. k. Geol. Reichsanst.*, X, 1882) and identified with *Hungarites Pradoi* Vern. But the number of falciform ribs is considerably larger and the lateral tubercles are less prominent in my Indian examples. It is indeed scarcely correct to speak of lateral tubercles, the appearance of such being

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rather produced by the presence of deep grooves, which are arranged along a spiral line in the middle of the flanks. In this character the specimens somewhat recall *Buddhaites Rama*. Their identification with this species is of course at once excluded by the difference in their suture lines.

From *H. Sagorensis* Mojsisovics (*l.c.*, p. 232, Pl. LXI, fig. 1) this species is distinguished by the complete absence of umbilical tubercles. There is, indeed, no Alpine species of the genus *Hungarites*, to which it exhibits a close affinity. Among the congeneric species of the American Trias, *Hungarites Yatesi* Hyatt et Smith (Triassic Cephalopod genera of North America, *U. S. Geol. Surv. Prof. Pap.* No. 40, p. 129, Pl. XX, figs. 1—4) from the Lowest Trias of California is not so highly sculptured and has the central keel separated more distinctly from the marginal shoulders.

Sutures.—Ceratitic, with the normal number of lateral lobes. Not known in detail.

Locality, number of specimens examined.—Lower Gymnites layer, Pastannah, hor. **1, 27**-8-09, **3**.

Gen. Sibirites Mojs.

Sibirites cf. Prahlada Diener.

(Pl. VIII, fig. 6.)

1895. *Sibirites Prahlada* Diener, Himalayan Foss., *Palæontologia Ind.*, ser. XV, Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 37, Pl. VII, fig. 5.
1907. *S. cf. Prahlada* Diener, *ibidem*, Vol. V, Pt. 2, Fauna of the Himalayan Muschelkalk, p. 99.

A fairly well preserved specimen of small size is referred to this beautiful species with some hesitation, because it differs from the type in having higher whorls and by the outlines of its transverse section, which are more strongly rounded. But in their sculpture the two examples from the Shalshal cliff and from Kashmir agree exactly, especially in the development of crescent-shaped tubercles in the vicinity of the siphonal margin which mark a point of bifurcation in the strong lateral ribs. These lunular tubercles are visible within the umbilicus, the spiral of involution corresponding exactly with the summits of their crests.

Dimensions.—Diameter of the shell		26 mm.
,, ,, umbilicus		7 ,,
Height	of the last volution	18·5 ,,
Thickness	of the last volution	14 ,,

My specimen consists of air-chambers only, no trace of the body-chamber having been preserved. It must, consequently, have attained much larger dimensions than my type-specimen from the beds with *Rhynchonella Griesbachi* of the Shalshal cliff, in which nearly two-thirds of the last volution belong to the body-chamber. All the examples known to me from the Lower Muschelkalk of Lilang are also of small size, although provided with their body-chambers. This is

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another character, which together with the difference in shape of the transverse section prevents me from venturing on a direct identification of the form from Kashmir with *Sibirites Prahlada.*

An identification with *Keyserlingites* is precluded both by the different ornamentation of the inner volutions and by the position of the lunular tubercles in the last whorl.

Locality, number of specimens examined.--Lower Gymnites beds, Pastannah, hor. **3,** 3-9-09, **1.**

Gen. Proteites Hauer.

Proteites indicus nov. sp.

(Pl. VI, fig. **2.**)

In 1887 the generic denomination *Proteusites* has been introduced for a species from the Muschelkalk of Han Bulog in Bosnia (*Proteusites Kellneri*) by F. v. Hauer (Die Cephalopoden des bosnischen Muschelkalkes von Han Bulog in Bosnien, *Denkschr. kais. Akad. Wiss.*, Bd. LIV, p. 27). In 1892 a considerable number of forms, allied more or less closely to *P. Kellneri*, were described by this author (Cephalopoden aus der Trias von Bosnien, I, Neue Funde aus dem Muschelkalk von Han Bulog, *l.c.*, Bd. LIX, p. 267). As distinctive characters of this genus the following have been enumerated: "Volutions enveloping each other considerably, more or less globose in young stages of growth, but subject to considerable alterations of shape in the adult individual. Body-chamber distinguished by an egression of the umbilicus. Rounded siphonal area, which passes gradually into the lateral parts. Strong, radial plications on the surface of the body-chamber, meeting along the median zone of the siphonal area without interruption, and raised into strong tubercles along the umbilical margin. Constrictions or labiæ probably present in all nuclei, although they have been actually observed in a small number of species only."

E. v. Mojsisovics (Cephalopoden der Hallstätter Kalke, *Abhandl. k. k. Geol. Reichsanst.*, Bd. VI-2, p. 812) proposed to discard the name *Proteusites*, which he considers to be a vox hybrida, in favour of *Proteites.*

In the Muschelkalk of Kashmir the genus *Proteites* is represented by a beautiful species, which is closely allied to *P. Kellneri* Hauer (*l.c.*, p. 27, Taf. VII, figs. 1—4).

The only specimen available for examination is provided with a portion of its body-chamber, to which exactly one-half of the last volution belongs. At first sight it strongly resembles some species of *Ptychites* (*P. Everesti* Opp.) from which it is, however, fundamentally distinguished, not only by its ceratitic sutures, but also by the presence of strong tubercles, which are arranged along the umbilical margin and are separated by deep intercostal valleys. Twelve umbilical tubercles are counted within the circumference of the last volution

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From those tubercles broad folds originate, which broaden out but diminish considerably in strength towards the siphonal part across which they pass.

The maximum thickness of the whorls coincides with the umbilical margin from which the slightly convex sides converge regularly towards the siphonal part, which is narrowly rounded and, in the anterior portion of the last whorl, is even provided with an obtuse, indistinct edge. The umbilicus is very deep and bordered by a steep inner wall which is quite smooth.

The involution takes place outside the spiral line of umbilical tubercles. The egression of the spiral of involution is confined to the body-chamber and is inconsiderable, though clearly marked.

Dimensions.—Diameter of the shell		69 mm.
,, ,, umbilicus		21·5 ,,
Height	of the last volution	26·5 ,,
Thickness	of the last volution	42 ,,

Sutures.—Ceratitic, agreeing in general with those of *Proteites Kellneri* Hauer, but distinguished by an approximately serial arrangement of their elements. The siphonal lobe is the deepest. Lobes comparatively narrow, with few denticulations, saddles broad, the siphonal and principal lateral saddles of nearly equal dimensions. The first auxiliary saddle is divided by the umbilical margin. Two auxiliary lobes and saddles outside the umbilical suture.

Locality, number of specimens examined.—Ptychites layer, gap on ridge N. 15 W. of Khrew, Vihi district, hor. **2,** 16-9-09, 1.

Remarks.—Among the species of *Proteites* from the Bosnian Muschelkalk, *Proteites Kellneri* Hauer and *P. robustus* Hauer (*l.c.*, Vol. LIX, p. 268, Taf. VI, fig. 1) are nearly allied to *P. indicus.* Both of them are distinguished from our Indian type by their more strongly compressed volutions and by differences in the details of the sculpture. The sculpture of *P. indicus* agrees closely with that exhibited in the chambered portion of the last whorl of *P. Kellneri,* but does not show the sharp and narrow folds, which are characteristic of the body-chamber of that species. In *P. robustus* the number of umbilical tubercles is smaller. A slight change in the ornamentation of the body-chamber is also exhibited in *P. indicus,* the last three umbilical tubercles preceding the aperture standing less widely apart than the rest.

Gen. Acrochordiceras Hyatt.

Acrochordiceras cf. enode Hauer.

(Pl. VII, fig. 7.)

1892. *Acrochordiceras enode* F. v. Hauer, Beiträge zur Kenntnis der Cephalopoden aus der Trias von Bosnien, I, Neue Funde aus dem Muschelkalk von Han Bulog, *Denkschr. kais. Akad. Wissensch.*, LIX, p. 272, Taf. VII, fig. 1.

1896. *A. enode* G. v. Arthaber, Cephalopodenfauna der Reiflinger Kalke, *Beiträge zur Geol. u. Palæontol. Oesterr.-Ungarns*, etc., Bd. X, p. 81.

Two specimens of *Acrochordiceras* in the Himalayan collection are distinguished by the absence of tubercles in their sculpture which consists of radial ribs

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only. Both of them are, unfortunately, fragmentary and do not admit therefore of a safe identification.

The larger and more complete specimen agrees particularly well with the type of *A. enode* Hauer. It has a diameter of more than 60 mm., high and strongly compressed whorls and a narrow umbilicus. The ribs are nearly straight, narrow and acute in the umbilical region, but increase in width considerably towards the siphonal margin, where they describe a faintly marked curve, with its convexity turned forward. The majority of ribs take their origin in the umbilical edge. Intercalated ribs are comparatively small in number.

The specimen is also very nearly allied to *Acrochordiceras pustericum* Mojsisovics (Cephalopoden der Mediterranen Triasprovinz, *Abhandl. k. k. Geol. Reichsanst.*, X, p. 143, Taf. VI, fig. 4). There is, indeed, some probability of the two Mediterranean species being identical. The specific differences, as enumerated by F. v. Hauer and G. v. Arthaber, are of very small importance. Hauer insists on the smaller size and the presence of more slowly increasing whorls in *A. pustericum*, two characters which appear to me as of a rather doubtful value. G. v. Arthaber lays a special stress on the less compressed and more evolute shape of *A. enode*. If the sutural line of *A. pustericum*, which up to now is not known, could be proved to agree with that in *A. enode*, I should not hesitate to unite the two species.

The second fragment is characterized by its broader and more falciform ribs. I did not venture on a specific determination, although it reminds me of the body-chamber fragment of *A. undatum*, illustrated in G. v. Arthaber's memoir on the Cephalopod-fauna of the Reiflingerkalke (*l.c.*, p. 79, Pl. VII. fig. 7). There is, indeed, some confusion about the specific value of *A. undatum*. The complete specimens, which have been described and figured later on by G. v. Arthaber (*l.c.*, p. 235, Taf. XXVII, fig. 2), do not exhibit any difference from *A. Carolinæ* v. Mojsisovics, as has been remarked in my memoir on the fauna of the Himalayan Muschelkalk (*Pal. Ind.*, ser. XV, Himalayan Foss., Vol. V, Pt. 2, p. 101), but the body-chamber quoted above might still represent a proper species, provided its umbilical margin is really free from any tubercles throughout its entire circumference.

Locality, number of specimens examined.—Layer with *Rhynchonella trinodosi*, ridge N. 15° W. of Khrew, Vihi district, hor. **3,** 15-9-09, **1.**

Acrochordiceras cf. Balarama Diener.

1895. *Acrochordiceras Balarama* Diener, Himal. Foss., *Pal. Ind.*, ser. XV, Vol. II, Pt. 2, Cephalopoda of the Himal. Muschelkalk, p. 35, Pl. VII, fig. 3.
1907. *A. Balarama* Diener, *ibid.*, Vol. V, Pt. 2, Fauna of the Himal. Muschelkalk, p. 102.

Two small examples of *Acrochordiceras* are included in this species, on account of the circular transverse section of their inner volutions, the large number of ribs and the insignificant development of umbilical tubercles, all characters by which the present form is distinguished from *A. Carolinæ* Mojs., although they

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might be considered as being only of varietal importance if the Alpine species is taken in a somewhat wider range of circumscription, as it has been advocated by A. v. Krafft (*General Report, Geol. Surv. of India for 1898-99*, p. 19).

Locality, number of specimens examined.—Upper Gymnites layer, Pastannah, hor. **2,** 27-8-09, 1. Lower Gymnites layer, Pastannah, hor. **3,** 3-9-09, 1.

ACROCHORDICERAS cf. HAUERI Arth.

(Pl. VII, fig. 8.)

1887. *Acrochordiceras Damesi* Hauer (non Noetling), Cephalopoden des Bosnischen Muschelkalkes von Han Bulog bei Sarajevo, *Denkschr. kais. Akad. Wissensch.*, Bd. LIV, p. 22, Pl. V, fig. 2.

1911. *Acrochordiceras Haueri* G. v. Arthaber, Die Trias von Albanien, *Beiträge z. Geol. u. Palæontol. Oesterr.-Ungarns*, etc., XXIV, p. 272.

It has been remarked both by E. v. Mojsisovics (Cephalopoden der Hallstaetter Kalke, *Abhandl. k. k. Geol. Reichsanst.*, VI-2, 1893, p. 813) and by myself (Fauna of the Himal. Muschelkalk, *l.c.*, p. 99), that the identification of Hauer's species from Han Bulog with *Acrochordiceras Damesi* Noetling (*Zeitschr. d. Deutsch. Geol. Ges.*, 1880, p. 334, Taf. XV) from the German Muschelkalk cannot be maintained, since remarkable differences between them exist, especially in the arrangement of the sutural line. A new specific denomination must consequently be introduced for the Bosnian form. As such the name of *Acrochordiceras Haueri* was proposed by G. v. Arthaber.

To this species an example in the Himalayan collection appears to be most nearly allied. In the large number of umbilical tubercles and in the small development of intercalated ribs, which do not originate from such tubercles, it agrees better with *A. Haueri* than with *A. Carolinæ* Mojs. Notwithstanding F. v. Hauer's opinion to the contrary those two species, which are very closely allied, should not be united. As chief difference between them I am inclined to consider the different position of the umbilical tubercles. Those are situated exactly along the periphery of the umbilical margin in *A. Carolinæ*, whereas they are shifted considerably towards the flanks in *A. Haueri*. In this character my Himalayan specimen also agrees with the latter species.

Locality, number of specimens examined.—Lam, Patarkul valley, hor. **3,** 16-8-09, 1.

Gen. ISCULITES Mojs.

This genus, which in the Alpine region is limited to stages of Upper Triassic age only, is represented in the Muschelkalk of Kashmir by three new species, none of them identical with *Isculites Hauerinus* from the Muschelkalk of Spiti.

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Isculites Middlemissii nov. sp.

(Pl. X, fig. 1.)

All Alpine representatives of *Isculites* hitherto known are dwarf-species. In the Himalayan collection from Kashmir there is a specimen before me, attaining a diameter of 39 mm., which is, however, not completely chambered. But the commencement of the egression of the umbilicus has led me to the conclusion that the last septa cannot have been situated at a considerable distance from the commencement of the body-chamber. Including the body-chamber, which comprises at least one more volution, the diameter of the complete individual cannot have been much less than 50 mm.

Isculites Hauerinus Stoliczka (*Mem. Geol. Surv. of India*, Vol. V, Pt. I. p. 50, Pl. IV, fig. 3), it is true, reaches dimensions not much inferior to the present species, but cannot be identified with it, on account of some remarkable differences in its shape and sutures. Our species is globose and has the external shape of *Proarcestes*, the height of the last volution from the umbilical suture measuring less than one-half its width. It is, therefore, quite natural that after a cursory examination it was referred provisionally to *Proarcestes* by C. S. Middlemiss, until its true affinities were revealed by a closer inspection of the sutural line. In *Isculites Hauerinus* the whorls are much more strongly compressed, and in the last volution the transverse section becomes almost helmet-shaped, with a siphonal part narrowly rounded.

The umbilicus is wider than in the Indian species of *Proarcestes*, from the Muschelkalk, even than in *P. bicinctus* Mojs.

The specimen is a cast devoid of its shelly substance, and strongly weathered, but I have succeeded in clearing an undestroyed surface of the cast by splitting off a small part of the last volution. This surface is quite smooth. In the first quarter of the last whorl a narrow and very low ridge is noticed, which probably corresponded to an internal furrow of the shell.

Dimensions.—Diameter of the shell	39	mm.
,, ,, umbilicus	10	,,
Height of the last volution	14·5	,,
Thickness of the last volution	35	,,
Height of the last volution above the umbilical suture	8	,,

Sutures.—A correct illustration of the sutures of *Isculites Hauerinus* Stol. has been published in my memoir on the Cephalopoda of the Himalayan Muschelkalk (Himal. Foss., Vol. II, Pt. 2, Pl. XXXI, fig. 11). Its suture line is provided with three principal lobes and saddles and with two auxiliary elements. The saddles are brachyphyllic, with the exception of their rounded tops, which are entire, and of the smooth external wall of the siphonal saddle.

In the present specimen an equal number of sutural elements is noticed, but their general arrangement differs considerably from that noticed in *I. Hauerinus*.

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The sutures are nearly ceratitic, not brachyphyllic, the marginal walls of the principal saddles being but very slightly serrated. It is rather difficult to state the number of lateral lobes exactly. The projection of the periphery of the penultimate whorl touching the principal lateral saddle in the last volution, I prefer to consider the lobe following this saddle as a second lateral lobe, not as an auxiliary element, and this so much the more, as it surpasses the principal lateral lobe in width. The small size of the principal lateral lobe, as compared with the second, is one of the most remarkable features in the sutural line of the present species.

The siphonal lobe stands at an equal level with the principal lateral lobe. It is divided by a short median prominence. Each of its two wings terminates in three small indentations. The three principal saddles are of equal height.

Locality, number of specimens examined.—Ptychites layer, near spur N.N.E. of Khunmu, Vihi district, hor. **7,** 11-8-08, 1.

Isculites sp. ind. (I).

(Pl. X, fig. 2.)

The only specimen available for description is provided with its body-chamber, which comprises more than one entire volution. The external portion of the body-chamber whorl has been broken off, thus leaving the penultimate whorl for one-half of its circumference. The last volution shows very clearly the remarkable egression of the umbilicus, characteristic of the genus *Isculites*.

From *Isculites Middlemissii* this species is distinguished by its less globose shape, but agrees with it in the regularly rounded outlines of the siphonal part. This might serve as a character of distinction from *I. Hauerinus*. The proportions of height and thickness in the penultimate whorl are 14 to 20 mm. corresponding to a diameter of the shell of 30 mm.

Sutures.—Not known in detail.

Locality, number of specimens examined.—Top-bed of Lower Gymnites layer, Pastannah, hor. **1,** 27-8-08, 1.

Isculites sp. ind. (II).

(Pl. X, fig. 3.)

The only specimen available for description is of very small size, but provided with its body-chamber, to which the last entire volution belongs. It is perfectly smooth, without any sulcus or varix. The egression of the umbilicus is distinctly marked, notwithstanding its small dimensions.

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The transverse section is extremely broad and low, the height of the aperture measuring only one-third part of its width. The siphonal area is flatly arched and even level for a considerable distance at the beginning of the last volution.

Dimensions.—Diameter of the shell		20	mm.
,, ,, umbilicus		6	,,
Height of the last volution	above the umbilical suture	5	,,
	,, ,, preceding whorl	2·5	,,
Thickness of the last volution		15	,,

Locality, number of specimens examined.—Upper Gymnites layer, **1** mile W. of Pastannah, hor. **1,** 8-9-09, **1.**

Remarks.—This species cannot be identified with any of the forms previously described. From *I. Hauerinus* and *I. sp. ind.* (I) it is distinguished by the different proportions of its transverse sections. Inner nuclei of *I. Middlemissii* might perhaps better agree with it in this respect, but there is very little probability of their identity, considering the remarkable difference in the egression of the umbilicus. The sutures of the present species are, unfortunately, not known in detail, but there are certainly two auxiliary lobes developed, which are separated by a very low saddle.

The present form seems to be after all a dwarf species, as are the majority of Alpine representatives of the genus *Isculites.*

Gen. Smithoceras Dien.

Smithoceras Herminæ nov. sp.

(Pl. VII, figs. 9, 10.)

1895. *Nov. gen. ind. ex fam. Arcestidarum sp. ind.* Diener, Himal. Foss., *Pal. Ind.*, ser. XV, Vol. II, Pt. 2, Cephalop. of the Muschelkalk, p. 85, Pl. XXVIII, figs. 2, 3.

From the Muschelkalk of the Shalshal cliff an Ammonite was described by myself in 1895, which, although too poorly preserved for a specific determination, was considered to hold an independent generic position, on account of the remarkable arrangement of its suture line. In 1907 I was able to refer this form to the genus *Smithoceras* Diener (*l.c.*, Vol. V, Pt. 2, Fauna of the Himalayan Muschelkalk, p. 97). In the Himalayan collection from Kashmir two specimens of *Smithoceras* have been found, which I am inclined to consider as being identical with the form from the Shalshal cliff. One of them is provided with its body-chamber and agrees exactly with the specimen illustrated in fig. 2 of my memoir quoted above, in all its external characters, being only of slightly smaller size. The second is an inner nucleus, measuring 15 mm. along its diameter. Its sutural line agrees exactly with that of the chambered type from the Shalshal cliff illustrated in fig. 3.

Our more complete knowledge of this species induces me to propose a proper specific denomination.

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This species cannot be identified with *Smithoceras Drummondii* Diener (*l.c.*, Vol. V, Pt. 2, p. 98, Pl. XII, fig. 3) from the Muschelkalk of Jolinka, Byans. It is of smaller dimensions, is considerably broader, the width of the last volution in full-grown specimens being at least one double of its height, and is provided with a very narrow umbilicus, which appears to have been closed by a callosity in the adult stage. *Sm. Drummondii* is more strongly compressed and is distinguished by a wide, open umbilicus.

Dimensions.—Diameter of the shell	19	mm.
,, ,, umbilicus	2	,,
Height of the last volution: above the umbilical suture	9	,,
Height of the last volution: ,, ,, preceding whorl	3·5	,,
Thickness of the last volution	21·5	,,

Locality, number of specimens examined.—Loose block, Pastannah, Traal valley, 1. Gymnites layer, Temple hill, Khrew, hor. **2,** 17-9-09, 1.

SMITHOCERAS sp. ind.

(Pl. IX, fig. 3.)

This species seems to hold an intermediate position between *Smithoceras Herminæ* Dien. and *S. Drummondii* Dien. The only imperfect example available for examination is a chambered nucleus. It is regularly globose, compressed less strongly than *S. Drummondii*, but considerably more so than *S. Herminæ*. Transverse section regularly rounded. Umbilicus narrow.

Dimensions.—Diameter of the shell	34	mm.
,, ,, umbilicus	3	,,
Height of the last volution: above the umbilical suture	19	,,
Height of the last volution: ,, ,, preceding whorl	6	,,
Thickness of the last volution	32	,,

Sutures.—Not known in detail. Dolichophyllic, and agreeing in their arrangement with those of *S. Drummondii*, but more richly serrated.

Locality, number of specimens examined.—Upper Gymnites layer, Pastannah, hor. **1,** 27-8-09, 1.

The specimen is too fragmentarily preserved to justify the introduction of a proper specific denomination.

Gen. PINACOCERAS Mojs.

PINACOCERAS cf. LOOMISII Dien.

1907. *Pinacoceras Loomisii* Diener, Himalayan Foss., *Pal. Ind.*, ser. XV, Vol. V, Pt. II, Fauna of the Himalayan Muschelkalk, p. 123, Pl. XVII, figs. 1—3.

There are several fragments of *Pinacoceras* in the Himalayan collection, but all of them preserved so poorly, that any specific determination becomes utterly

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impossible. Two fragments only exhibit a portion of the sutural line sufficiently well to allow a close comparison with *P. Loomisii* from the Muschelkalk of Byans. In this sutural line two bipartite saddles, the primary external and an adventitious one, agree with the corresponding elements in *P. Loomisii.*

Locality, number of specimens examined.—Ptychites beds, E. of Guryul ravine, Khunmu, hor. **7, 11**-8-08, **2**.

Gen. Ptychites Mojs.

In the materials collected in Kashmir by C. S. Middlemiss the genus *Ptychites* is still more poorly represented than in the Muschelkalk of Spiti. The four species known to me belong to the group of *megalodisci*, whereas the group of *rugiferi*, which plays the most important part in the Muschelkalk of Painkhanda and Johar, is entirely absent. One of those species is identical with *P. Sahadeva* Dien. from the Muschelkalk of Byans. The rest are new. All of them are distinguished by wide, open umbilici, a character which is comparatively rare in Alpine *megalodisci.*

Ptychites Sahadeva Dien.

1895. *Ptychites Sahadeva* Diener. *Palæont. Ind.*, ser. XV, Himalayan Foss., Vol. II, Pt. Cephalopoda of the Muschelkalk, p. 71, Pl. XXV, figs. 1, 2.

A large specimen of *Ptychites* agrees in all essential points of shape, sculpture and sutures so closely with this species from the Muschelkalk of Byans, that I cannot find any reason for a specific separation.

It shows the elliptical outlines, characteristic of the type from Kalapani, which I can no longer consider as an accidental deformity, due to crushing, but which is more probably a feature of specific importance. The penultimate whorl having been partly broken off, a considerable portion of the internal nucleus is accessible to examination. This is strongly inflated, exactly as in young individuals of *P. Sahadeva* from Kalapani and has the siphonal part rounded more acutely than the adult specimen. The funnel-shaped umbilicus does not show any egression of the spiral in the last whorl, but it must be remarked that the present example is not completely chambered, and if completely preserved, must consequently have attained much larger dimensions than the type-specimen from Byans.

The surface of the cast having suffered from weathering, its ornamentation has almost completely disappeared. Faint traces of radial folds are noticed occasionally.

Dimensions.—Diameter of the shell		156 mm.
,, ,, umbilicus		28 ,,
Height	of the last volution	76 ,,
Thickness	of the last volution	67 ,,

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Sutures.—Agreeing with those of my type-specimen of *Ptychites Sahadeva* from Kalapani. The difference in the height of the siphonal and principal lateral saddles is, however, less strongly marked. The bipartite character of the second lateral and first auxiliary saddles is exhibited as clearly as in the type.

Locality, number of specimens examined.—Ptychites layer, spur N.N.E. of Khunmu, Vihi district, hor. near **7, 11**-8-08, **1.**

PTYCHITES BARCLAYI nov. sp.

(Pl. IX, figs. 1, 2.)

Ptychites Sahadeva takes an intermediate position between two groups of *megalodisci* in the Muschelkalk of Kashmir. On the one hand it is allied to two species, in which the inflated shape during adolescence persists throughout all stages of growth; on the other hand it shows a close affinity with a flatter, discoidal form in which, however, the flattening of the volution is combined with a contraction of the umbilicus as small as in *P. Sahadeva.* This last species, for which the name of *P. Barclayi* is proposed, resembles *P. evolvens* Mojsisovics (Cephalopoden Mediterran. Triasprovinz, *Abhandl. k. k. Geol. Reichsanst.*, X, p. 254, Taf. LXXV, figs. 1, 4; LXXVI, fig. 1) and *P. reductus* Mojs. (*ibid.*, p. 252, Taf. LXVIII) among the European congeneric forms.

The inner volutions of this species are not known to me. I am consequently unable to fix the stage of growth, in which the flattening of the shell sets in. All my specimens are distinguished by a distinctly discoidal shape, the greatest transverse diameter corresponding with the umbilical margin, which is sharply rounded. The siphonal part is narrowly rounded, as in *P. reductus* Mojs. or in *P. Sumitra* Dien., not acute, as in *P. megalodiscus* Beyr. or in *P. evolvens* Mojs.

In all my specimens the egression of the umbilicus begins not far from the inner extremity of the last volution and gradually increases towards the aperture. It is, however, less strongly marked than in *P. evolvens*, which is, moreover, distinguished from our species by the presence of a sharp umbilical edge.

On the surface of the casts faint traces of radial grooves have been occasionally noticed, which correspond to depressions between broad, indistinct folds.

All my specimens are entirely chambered.

		I.	II.
Dimensions.—Diameter of the shell		204 mm.	224 mm.
,, ,, umbilicus		29 ,,	37 ,,
Height of the last volution	above the umbilical suture	104 ,,	116 ,,
	,, ,, preceding whorl	61 ,,	62 ,,
Thickness of the last volution		72 ,,	76 ,,

Sutures.—Similar to those of the discoidal representatives of the group of *megalodisci*, especially in the rich development of lateral branches in the saddles and in the size of the siphonal saddle. Although this saddle is not fully known to me, it is certainly of comparatively large dimensions, individualised much more strongly than in the group of *rugiferi*, and provided with richly foliaceous

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secondary branches. The lobes end in single terminal digitations with corresponding lateral ones, each being divided at its base by two large converging phyla. Second lateral saddle and auxiliary saddles bipartite. The saddles are provided with broader and stronger stems than in *P. megalodiscus*. Four auxiliary lobes are noticed outside the umbilical region, the margin of which coincides with the fourth auxiliary saddle.

Locality, number of specimens examined.—Ptychites layer, spur N.N.E. of Khunmu, Vihi district, hor. **7, 11**-8-08, **3**.

Remarks.—*Ptychites Barclayi* is certainly an independent species, which can be easily distinguished from the congeneric forms belonging to the group of *megalodisci*. There is no close affinity either with the European *P. megalodiscus* Beyr. or with the Indian *P. Sumitra* Dien., which are provided with narrow umbilici. *P. evolvens* Mojs. differs from our species by a more strongly marked egression of the umbilicus, by an acute umbilical margin, and by a more sharply rounded siphonal part. In *P. reductus* Mojs. the proportions of height and thickness are somewhat different, the transverse diameter of the last volution being only one-half its height in specimens of equal size. In the arrangement of their sutures the two species agree both in the development of broad stems and in the remarkable contrast of the large principal with the small auxiliary saddles, but in *P. Barclayi* the second lateral saddle is distinctly bipartite, whereas in *P. reductus* it agrees in shape with the principal lateral saddle.

PTYCHITES CUNNINGHAMI nov. sp.

(Pl. X, fig. 4.)

Ptychites Cunninghami belongs to a section of the group of *megalodisci*, in which the globose shape of the inner nuclei persists throughout all stages of growth. Even in specimens twice as large as my type of *P. Sahadeva* the thickness of the last volution is nearly equal to the height, and in examples of equal dimensions the aperture is considerably broader than high. This section is represented by *P. Pauli* Mojsisovics (Cephalopoden Mediterr. Triasprovinz, *Abhandl. k. k. Geol. Reichsanst.*, X, p. 251, Taf. LXII, fig. 2), *P. domatus* Hauer (*Denkschr. Akadem. Wiss. Wien*, II, 1851, p. 115, Taf. XVIII, fig. 12), *P. seroplicatus* Hauer (*Denkschr.*, LIX, 1892, p. 285, Taf. XII, fig. 2; XIII, fig. 1), *P. patens* Hauer (*l.c.*, p. 286, Taf. XIII, fig. 2), *P. pusillus* Hauer (*l.c.*, p. 287, Taf. XIII, fig. 3) among the fauna of the Mediterranean region, and by *P. impletus* Oppel in the fauna of the Indian Muschelkalk. But there is no very close affinity between any of the above-quoted species and our Himalayan form.

At a first glance *P. Cunninghami* strongly recalls a representative of the Indian *rugiferi*. This external similarity is chiefly due to the inflated shape of the shell and to the ornamentation, which consists of distinct radial folds, as in *P. patens* Hauer. But the sharpened siphonal part, the helmet-shaped cross-section, and the coincidence of the umbilical edge with the greatest transverse

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diameter are all characters which forbid a grouping of our species with the section of *rugiferi* and oblige me to include it in the section of *megalodisci*.

In one of my specimens twenty radial folds have been counted on the last volution.

	I.	II.
Dimensions.—Diameter of the shell	188 mm.	147 mm.
,, ,, umbilicus	35 ,,	36 ,,
Height of the last volution { above the umbilical suture	92 ,,	58 ,,
Height of the last volution { ,, ,, preceding whorl	50 ,,	30 ,,
Thickness of the last volution	90 ,,	77 ,,

Sutures.—Similar to those of *P. patens* Hauer and *P. Pauli* Mojs. but distinguished by a stronger individualisation of the siphonal saddle, which is broad and massive. Siphonal lobe very short and divided by a median prominence which in height is scarcely inferior to the siphonal saddle. Lateral lobes terminating in three digitations, of which the central one is the largest. Second lateral and auxiliary saddles bipartite and deeply incised above. The stems of the saddles are much broader than in *P. Sahadeva*. Exact number of auxiliary lobes not known.

Siphuncle.—In one of my examples a siphuncle is seen, which in its position does not correspond exactly with the siphonal edge, but is shifted somewhat to the left at the beginning of the last volution.

Locality, number of specimens examined.—Ptychites layer, spur N.N.E. of Khunmu, Vihi district, hor. **7, 11**-8-08, **5**.

PTYCHITES BRÜCKNERI nov. sp.

(Pl. VI, figs. 1, 2.)

This species is nearly allied to *Ptychites Cunninghami*, from which it is chiefly distinguished by the remarkable size of its umbilicus. In this respect it takes a similar position among the section of *megalodisci*, as *P. Govinda* Dien. (Cephalopoda of the Muschelkalk, Himal. Foss., Vol. II, Pt. 2, p. 69, Pl. XXI) among the group of *rugiferi*.

At a first glance it recalls *P. Govinda*, from which it differs only in some subordinate details. The lateral parts converge towards the siphonal area without any convexity. The siphonal part is more narrowly rounded, though not acute. The involution does not take place exactly at the umbilical margin, a narrow zone of the inner volutions is therefore exposed within the stairlike umbilical area.

My specimen has about 20 radial folds within the last volution. They are flatly convex, rising from the umbilical margin, and broadening out and flattening gradually, as they approach the siphonal region.

Dimensions.—Diameter of the shell	101	mm.
,, ,, umbilicus	28·5	,,
Height of the last volution { above the umbilical suture	42	,,
Height of the last volution { ,, ,, preceding whorl	30	,,
Thickness of the last volution	59	,,

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Sutures.—Very similar to those of *Ptychites Gorinda*. The two lateral and the first auxiliary lobes are all of equal depth. They are not divided at their base by large central points, as in *P. Gorinda*, but end in single terminal with corresponding lateral digitations. Siphonal lobe very short. Saddles highly foliaceous, with their stems deeply incised. Second lateral saddle provided with a well individualised secondary inner branch, as in *P. Gorinda* or in *P. Malletianus* Stol. Number of auxiliary elements not exactly known. The umbilical edge touches the second auxiliary saddle.

Locality, number of specimens examined.—Lam, Patarkul valley, hor. **3½**, 16-8-09, 1.

Gen. Gymnites Mojs.

As regards the number of individuals, the genus *Gymnites* plays the most important part in the Muschelkalk of Kashmir. Unfortunately the majority of specimens are either fragmentary or have been injured by weathering so much, that they do not allow of a specific determination.

Gymnites Jollyanus Oppel.

1863. *Ammonites Jollyanus* Oppel, *Paläontologische Mitteilungen aus dem Museum des kgl. Bayrischen Staates*, Stuttgart, I, p. 27, Taf. LXXV, fig. 4.

1895. *Gymnites Jollyanus* Diener, *Paläont. Indica*, ser. XV. Himalayan Foss., Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 51, Pl. X, fig. 7; XI, fig. 1; XII, fig. 1.

1907. *G. Jollyanus* Diener, *ibidem*, Vol. V, Pt. 2, Fauna of the Himalayan Muschelkalk, p. 109.

The Himalayan collection contains many examples of this Ammonite, which together with *Buddhaites Rama* Diener may be considered to be the most important fossil of the Muschelkalk of Kashmir.

The examination of a large number of well preserved examples proves the typical form (Oppel's type-specimen) to be subject to considerable variations in the width of the umbilicus. Some of my specimens are distinguished by narrow umbilici. In such individuals the proportions of the diameters of the shells and umbilici are as follows:—

	I.	II.	III.
Diameter of the shell	100 mm.	95 mm.	76 mm.
,, ,, umbilicus	20 ,,	16 ,,	14 ,,

Those measurements prove their umbilici to be considerably narrower than in Oppel's type-specimen, in which the corresponding measurements are 84 and 21 mm. But it is only right to add that all those specimens are connected by intermediate gradations and that there is no reason to separate this var. *anguste-umbilicata* from the present species.

One specimen, which is provided with a part of its body-chamber, attains very large dimensions. Its measurements are as follows:—

Diameter of the shell	315 mm.
,, ,, umbilicus	60 ,,
Height of the last volution	152 ,,

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It has been compressed so strongly that the original thickness of the last volution could not be ascertained. On the last whorl of this specimen the spiral tubercles, which are the most characteristic feature in middle-sized individuals, have entirely disappeared.

Locality, number of specimens examined.—Lower Gymnites layer, Pastannah, hor. **1,** 27-8-09, 9; upper Gymnites layer, Pastannah, hor. **2,** 27-8-09, 1; lower Gymnites layer, 1 mile W. of Pastannah, hor. **1,** 8-9-09, 10; lower Gymnites layer, Khrew, hor. **2,** 17-9-09, 2; Ptychites layer, Khrew, hor. **2,** 17-9-09, 1.

GYMNITES VASANTASENA Diener.

1895. *Gymnites Vasantasena* Diener, *Palæont. Ind.*, ser. XV, Himalayan Foss., Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 52, Pl. XIII, fig. 2.
1907. *G. Vasantasena* Diener, *ibidem*, Vol. V, Pt. 2, Fauna of the Himalayan Muschelkalk, p. 109.

Two specimens with strongly compressed whorls and wide umbilici exhibit the characters of specific importance, by which this species is distinguished from *Gymnites Jollyanus* Oppel. The diameter of the umbilicus is larger than in any of the wide-umbilicated examples of *G. Jollyanus* of equal size. The ornamentation consists of radial ribs, which are confined to the lower portion of the flanks and do not rise into lateral prominences. The principal lateral lobe has its base divided into two digitations. In its dimensions my large example agrees exactly with the type-specimen from the Muschelkalk of the Shalshal cliff.

Locality, number of specimens examined.—Lower Gymnites layer, 1 mile W. of Pastannah, hor. **1,** 8-9-09, 2.

GYMNITES cf. KIRATA Dien.

1895. *Gymnites Kirata* Diener, *Palæontol. Indica*, ser. XV, Himalayan Foss., Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 53. Pl. X, figs. 2, 3.
1907. *G. Kirata* Diener, *ibidem*, Vol. V, Pt. 2, Fauna of the Himalayan Muschelkalk, p. 112.

A fragmentary specimen of small size, with elliptical outlines and low but thick whorls, is probably referable to this species.

Locality, number of specimens examined.—Upper Gymnites layer, Pastannah, hor. **1,** 27-8-09, 1.

GYMNITES SANKARA Dien.

1895. *Gymnites Sankara* Diener, *Palæontol. Indica*, ser. XV, Himalayan Foss., Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 56, Pl. XI, fig. 2.
1907. *G. Sankara* Diener, *ibidem*, Vol. V, Pt. 2, Fauna of the Himalayan Muschelkalk, p. 112.

Of this characteristic species several fragmentary specimens have been met with in the Muschelkalk of Kashmir.

Locality, number of specimens examined.—Lower Gymnites layer, Temple hill, Khrew, hor. **2,** 17-9-09, 1; lower Gymnites layer, Pastannah, hor. **1,** 27-8-09, 1; hor. **3,** 3-9-09, 1.

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GYMNITES nov. sp. ind.

In 1893 a fragmentary Ammonite from the Lower Muschelkalk of Neuprags in Tyrol was described by E. v. Mojsisovics (*Verhandl. k. k. Geol. Reichsanst.*, p. 297) as *Ægoceras nov. f. ind.* It was referred to *Gymnites* by the same author in 1882 (Cephalopoden Mediterran. Triasprovinz, *Abhandl. k. k. Geol. Reichsanst.*, Bd. X, p. 232). It was, however, considered to differ from the rest of species of *Gymnites* by a remarkable feature, namely, by the ornamentation of its inner whorls, which are provided with transverse ribs, whereas in other species of the genus the inner volutions are smooth, and transverse ribs make their appearance only in comparatively later stages of growth. E. v. Mojsisovics hinted at the similarity of this mode of development with that of some Indian *Xenodisci* (*X. plicatus* Waag., *X. himalayanus* Griesb.), in which the transverse folds are likewise restricted to the inner whorls and become obsolete in the last volution.

To this unnamed Alpine species our Indian one from Kashmir appears to be closely allied. My fragment, corresponding to one-half of the entire shell, shows the inner whorls covered with strong, very broad and rounded transverse folds and has a smooth outer volution. It is certainly not identical with the Alpine form, exhibiting strongly elliptical outlines. From *G. Sankara* Dien. or *G. sp. ind. aff. Sankara* Dien. it differs not only by its remarkable sculpture, but also by its cordiform cross-section, the greatest transverse diameter of which coincides with the rounded umbilical margin.

Sutures.—I have only been able to examine the auxiliary series, but this clearly proves our species to belong to *Gymnites*, not to *Japonites*.

Locality, number of specimens examined.— Lower Gymnites layer, Pastannah, hor. **3,** 3-9-09, **1.**

Sub-gen. BUDDHAITES Dien.

BUDDHAITES RAMA Dien.

1895. *Gymnites (Buddhaites) Rama* Diener, *Palæont. Indica*, ser. XV, Himalayan Foss., Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 59, Pl. XIII, fig. 3; Pl. XIV, figs. 1, 2.
1907. *Buddhaites Rama* Diener, *ibidem*, Vol. V, Pt. 2, Fauna of the Himalayan Muschelkalk, p. 118.

This interesting species is represented in the Himalayan Muschelkalk from Kashmir by a large number of specimens, some of them in a very favourable state of preservation. But the descriptions in my above-quoted memoirs were based on an examination of such extensive materials, that I have scarcely anything to add.

Some of the full-grown examples from the Muschelkalk of Kashmir are even larger than the type from the Shalshal cliff, illustrated in Pl. XIV, fig. 1. The measurements of my largest specimen are as follows :--

Diameter of the shell	163	mm.
,, ,, umbilicus	13·5	,,
Height of the last volution	89	,,
Thickness of the last volution	33	,,

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These measurements show the present example to be more widely umbilicated and consequently provided with a lower aperture than the type from the Shalshal cliff. In both characters it is one of the extreme shapes among the collection. In specimens of so large dimensions the sculpture becomes obsolete, both the falciform ribs in the middle of the lateral parts, and the spiral line, along which they are arranged, disappearing gradually.

Sutures.—The development of the outer branch of the external saddle into a proper adventitious element has been noticed in the sutural line of several specimens of large size.

Locality, number of specimens examined.—Lower Gymnites layer, Pastannah, hor. **1,** 27-8-09, **16**; upper Gymnites layer, Pastannah, hor. **2,** 27-8-09, **1**; Ptychites layer, Khrew, hor. **2,** 16-9-09, **5**; lower Gymnites layer, Khrew, hor. **2,** 17-9-09, **1**; Lam, Patarkul valley, hor. **3,** 16-8-09, **1**; Ptychites layer, E. of Guryul ravine, hor. **7,** 11-8-08, **2**.

Sub-class: NAUTILOIDEA.

Gen. MOJSVAROCERAS Hyatt.

MOJSVAROCERAS KAGÆ Diener.

1907. *Mojsvaroceras Kagæ* Diener, *Palæontol. Indica*, ser. XV, Himalayan Foss., Vol. V, Pt. 2, Fauna of the Himalayan Muschelkalk, p. 27, Pl. II, fig. 8.

Several fragments of outer whorls and a fairly well preserved specimen agree with this species from the Muschelkalk of Spiti. The development of the complete specimen, which attains a diameter of 66 mm., shows that in the inner whorls the greatest transverse diameter coincides with the siphonal, not with the umbilical margin of the cross-section, but that this proportion is reversed in the adult stage. In the square-shaped transverse section of one of my smaller fragments a height of 18 mm. corresponds to a width of 19·5 mm., the umbilical and siphonal margins being equidistant from the median plane of the shell. Umbilical and marginal spines are as a rule developed less strongly than in my type-specimen from Kaga. They are not connected by any pilæ.

Large fragments of *M. Kagæ* resemble the species from Muth, which in my memoir quoted above has been described as *Mojsvaroceras sp. ind. aff. Kagæ* (*l.c.*, p. 28, Pl. II, fig. 9) in the shape of their transverse section, which is no longer square-shaped but rather trapezoidal. But the difference in the distance of the marginal and umbilical edges is always considerably less than that noticed in the type-specimen from Muth. Nor does the height of the volution surpass its width.

In some of the examples before me the volutions increase more rapidly than in *M. Kagæ*, a diameter of 65 mm. and 86 mm. corresponding to a width of the umbilicus of 23 and 30 mm. only, whereas in a typical specimen of *M. Kagæ* the respective measurements are 65 and 29 mm. Those examples have been determined as *Mojsvaroceras cf. Kagæ*.

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Sutures.—Agreeing entirely with those of *M. Kagæ.*

Locality, number of specimens examined.—Lower Gymnites layer, Pastannah, hor. **1,** 27-8-09, 3; Ptychites layer, gap on ridge N. 15° W. of Khrew, hor. **2,** 16-9-09, 2; Lower Gymnites layer, Temple hill, Khrew, hor. **2,** 17-9-09, 2; upper Gymnites layer, Khrew, hor. **1,** 17-9-09, 1; found loose below Ptychites layer, E. of Guryul ravine, Khunmu, hor. **7,** 11-8-09, 1; Lam, Patarkul valley, hor. **3¾,** 16-8-09, 1.

MOJSVAROCERAS sp. ind. aff. NIVICOLA Dien.

The fragment of an outer whorl with the impression of the inner nucleus in the matrix adhering to it, belongs to a species of *Mojsvaroceras*, which is certainly most nearly allied to *M. nivicola* Diener (*Palæont. Indica*, ser. XV, Himalayan foss., Vol. V, Pt. 2, Fauna of the Himalayan Muschelkalk, p. 27, Pl. II, fig. 6) from the Muschelkalk of Jolinka, Byans.

It is provided with slowly increasing volutions, which overlap one another along the siphonal part only. The last volution is of trapezoidal outlines and considerably broader than high. The greatest transverse diameter coincides with the umbilical margin, which is steeply rounded, not sharp, as in *M. nivicola.* The outlines of the shell are less strongly elliptical than in the latter species.

The fragment of the outer whorl belongs to the body-chamber, but the last septum has been preserved. It exhibits the sutural line, which agrees with that noticed in *M. nivicola.* The siphuncle is situated rather deeply below the centre.

Locality, number of specimens examined.—Lower Gymnites layer, Pastannah, hor. **3,** 3-9-09, 1.

Remarks.—The impression of the inner nucleus clearly shows that the coils of this species were not perforated. It cannot, consequently, be referred to the Mediterranean group of forms, which are allied to *M. Kellneri* v. Hauer (*Denkschr. kais. Akademie Wissensch. Wien*, LIV, p. 14, Taf. II, fig. 2).

Gen. THURINGIONAUTILUS Mojs.

THURINGIONAUTILUS sp. ind.

(Pl. VI, fig. 3.)

In my memoir on the fauna of the Himalayan Muschelkalk a representative of this interesting genus has been described as *Thuringionautilus sp. ind.* (Himalayan foss., Vol. V, Pt. 2, p. 29, Pl. II, fig. 3). The description has, however, been based on a very imperfect fragment, not worthy of a specific determination. A second species of *Thuringionautilus* is represented in the Himalayan collection from Kashmir, but, unfortunately, by a fragment as poorly preserved as the specimen from the Muschelkalk of Kaga. It is certainly not identical with the latter, being more strongly inflated and provided with a highly rounded siphonal part.

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There are three spiral rows of elongated tubercles present on either side of the shallow median depression, as in *Th. rectangularis* Hauer (Beitræge zur Kenntnis der Cephalopodenfauna der Hallstaetter Schichten, *Denkschr. kais. Akad. Wissensch. Wien*, IX, p. 145, Taf. I, figs. 1—4). The umbilical region is occupied by stout and straight pilæ, as in the species from Kaga. At the beginning of the last volution of this specimen a transverse diameter of 26 mm. corresponds to a height of 18 mm.

Sutures.—Septa standing closely to each other with a shallow siphonal and lateral lobe. Siphonal and umbilical saddles broad and flat.

Siphuncle.—Below the centre of the septa.

Locality, number of specimens examined.—Lower Gymnites layer, Pastannah hor. **1**, 27-8-09, 1.

Gen. Syringonautilus Mojs.

Syringonautilus sp. ind. ex aff. Carolinæ Mojs.

The fragment of a Nautilus closely allied to this Alpine species (E. v. Mojsisovics, Cephalopoden Mediterr. Triasprovinz, *Abhandl. k. k. Geol. Reichsanst.*, X, p. 287, Taf. LXXXIII, fig. 1) consists of two volutions, which are completely chambered. They are broader than high, increasing very slowly and overlapping one another but very little. Umbilical and siphonal margins rounded. The lateral parts are flatly arched, not parallel, as in *S. Spitiensis* Stol.

Sutures.—Septa standing comparatively close to each other, passing in a straight line across the siphonal area and with a shallow lobe across the lateral parts.

Siphuncle.—Not known.

Locality, number of specimens examined.—Lower Gymnites layer, Khrew, hor. **2**, 17-9-09, 1.

Gen. Grypoceras Hyatt.

Grypoceras Vihianum nov. sp.

(Pl. VI, figs. 4, 5.)

This interesting species exhibits a strong affinity with a group of Upper Triassic *Nautilidæ* (group of *Gryponautilus Suessii*), which are distinguished by their inflated shape and a very narrow umbilicus, which is even closed by a callosity in adult individuals. It is certainly more nearly related to young specimens of *Grypoceras galeatum* Mojsisovics (Cephalopoden der Hallstaetter Kalke, *Abhandl. k. k. Geol. Reichsanst.*, VI-1, p. 26, Taf. XII, fig. 1; XIII, figs. 1, 3) or *G. Suessii* Mojsisovics (*l.c.*, p. 26, Taf. VI, fig. 1; XIII, fig. 2) than to any of the congeneric forms from the Alpine or Indian Lower Trias or Muschelkalk.

The slowly increasing whorls completely overlap one another. The broad siphonal area is slightly concave and separated from the lateral parts by sharp

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edges. The flanks are parallel in the marginal region but diverge gradually towards the umbilical margin, where the shell attains its greatest transverse diameter. Umbilical margin rounded, umbilical wall steep and high.

I have not succeeded in freeing the narrow umbilicus from the tough matrix. It was possibly closed by a callosity in old age.

The surface of the shell is smooth, neither ornamented by small marginal tubercles nor by transverse edges as in *G. Suessii.*

Sutures.—Exhibiting an arrangement similar to that noticed in *G. mesodicum* Hauer (Cephalopoden des Salzkammergutes, *l.c.*, p. 36, Taf. X, figs. 4–6). A comparatively large external lobe corresponds to the siphonal area and a broad lateral lobe to the flanks. The apex of the external saddle exactly coincides with the marginal edge of the shell. The lateral lobe is followed by a small umbilical saddle.

Siphuncle.—Situated rather close to the centre, but its exact position cannot be indicated, the specimen, in which it has been noticed, having been deformed by pressure in the rocks.

Dimensions.—Diameter of the shell		67 mm.
,, ,, umbilicus		?
Height of the last volution	above the umbilical suture	38 ,,
	,, ,, preceding whorl	27 ,,
Thickness of the last volution		42 ,,

Locality, number of specimens examined.—Ptychites layer, gap on ridge N. 15° W. of Khrew, hor. **2,** 16-9-09, 2; lower Gymnites layer, Pastannah, hor. **1,** 27-8-09, **1.**

Gen. Paranautilus Mojs.

Paranautilus Kashmiricus nov. sp.

(Pl. XI, fig. 1.)

A fairly well preserved specimen, consisting of air-chambers only, appears to be nearly allied to *Paranautilus brembanus* Mojsisovics (Cephalopoden Mediterran. Triasprovinz, *Abhandl. k. k. Geol. Reichsanst.*, X, p. 283, Taf. XC, fig. 4) from the Raibl beds of Lombardy. The whorls increase rapidly, are nearly involute, and considerably thicker than high. They attain their greatest width in the umbilical region. From this place the lateral parts slope in an oblique curve towards the narrow umbilicus, without forming a distinct umbilical margin. The flanks and the flatly arched siphonal part meet in indistinct, obtusely rounded edges, which become obsolete in the vicinity of the aperture. But the cross-section is not as distinctly trapezoidal as in *P. brembanus.*

Shell smooth, without any trace of ornamentation.

Sutures.—Septa rather distant, running nearly straight across the siphonal area and describing a shallow lobe along the lateral parts. No umbilical saddle,

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but the sutural line exhibits a distinct geniculation at the lower termination of the lateral lobe.

Siphuncle.—Sub-central.

Dimensions.—Diameter of the shell		95 mm.
,, ,, umbilicus		7 ,,
Height of the last volution	above the umbilical suture	54 ,,
	,, ,, preceding whorl	42 ,,
Thickness of the last volution		66 ,,

Locality, number of specimens examined.—Lower Gymnites layer, Temple hill, Khrew, hor. **2,** 17-9-09, 1.

Gen. Orthoceras Breyn.

Orthoceras cf. campanile Mojsisovics.

1882. *Orthoceras campanile* v. Mojsisovics, Cephalopoden Mediterran. Triasprovinz, *Abhandl. k. k. Geol. Reichsanst.*, X, p. 291, Taf. XCIII, figs. 1—4.

1887. *O. campanile* v. Hauer, Die Cephalopoden des bosnischen Muschelkalkes, *Denkschr. kais. Akademie Wissensch. Wien*, LIV, p. 11.

1895. *O. campanile* Salomon, Geologische und palæontologische Studien über die Marmolada, *Palæontographica*, XLII, pp. 175, 197.

1896. *O. campanile* v. Arthaber, Cephalopodenfauna der Reiflinger Kalke, *Beitræge z. Geol. u. Palæontol. Oesterr.-Ungarns*, etc., X, p. 24.

1896. *O. campanile* v. Hauer, Beitræge zur Kenntnis der Cephalopoden aus dem Muschelkalk von Bosnien, *Denkschr. Akad.*, LXIII, p. 240.

1896. *O. cf. campanile* Diener, *Palæontol. Ind.*, ser. XV, Himalayan Foss., Vol. II, Pt. 2, Cephalopoda of the Muschelkalk, p. 87, Pl. XXVIII, fig. 8.

1896. *O. campanile* Toula, Eine Muschelkalkfauna vom Golf von Ismid in Kleinasien, *Beitræge z. Geol. u. Palæontol. Oester.-Ungarns*, etc., X, p. 161, Taf. XVIII, figs. 13, 14.

1899. *O. campanile* Tommasi, La fauna dei calcari rossi e grigi del Mte. Clapsavon, *Palæontographia Italica*, Vol. V, p. 16, Tav. II, fig. 1.

1900. *O. campanile* Diener, Die triadische Cephalopodenfauna der Schiechlinghoehe bei Hallstatt, *Beitræge z. Geol. u. Palæontol. Oesterr.-Ungarns*, etc., XIII, p. 36.

1904. *O. campanile* Martelli, Cefalopodi triasici di Boljevici, *Palæontographia Ital.*, X, p. 135.

1906. *O. campanile* Martelli, Contributo al Muschelkalk superiore del Montenegro, *ibidem*, XII, p. 153.

1907. *O. cf. campanile* Diener, Himalayan Foss., *l.c.*, Vol. V, Pt. 2, Fauna of the Himalayan Muschelkalk, p. 22.

1911. *O. campanile* Renz, Die mesozoische Fauna Griechenlands, I Teil, *Palæontographica*, LVIII, p. 31.

Of this common and widely distributed Triassic species fragmentary examples, consisting of body-chambers and of air-chambers, have been collected from the following localities:—Pastannah, hor. **1,** 8-9-09, hor. **1,** 27-8-09, and hor. **3,** 3-9-09; Lam, Patarkul valley, hor. **3¾,** 16-8-09; E. of Guryul ravine, Khunmu, hor. **7,** 11-8-08; Temple hill, Khrew, hor. **2,** 17-9-09.

Class: Conularida.

Gen. Conularia Mill.

Conularia sp. ind.

(Pl. XI, fig. 2.)

The genus *Conularia* is not typically represented in the Himalayan collection from Kashmir. An impression of elongated, pyramidal shape, with a deeply

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furrowed angle indicated between two lateral faces can, however, be referred to it with great probability. The shell was provided with a quadrangular cross-section, broadly pyramidal and tapering very rapidly. Transverse ridges sharp, not granulate, distant from one another little less than 1 mm. Median groove on the lateral face scarcely defined, not interrupting the transverse ridges.

Locality, number of specimens examined.—Ptychites layer, E. of Guryul ravine, Khunmu, hor. **7**, 11-8-08, 1.

Remarks.—Notwithstanding its indifferent state of preservation this species is of some interest, considering the extreme rarity of *Conularidæ* in Mesozoic strata. One single species, *C. triadica*, is as yet known from Upper Triassic beds (Bittner, *Verhandl. k. k. Geol. Reichsanst.*, 1890, p. 177), and a second one, *C. cancellata* Argel., from the French Lias. No species has been described hitherto from beds of Lower Triassic or of Muschelkalk age.

Class : Gasteropoda.

The class of Gasteropoda is neither richly represented in the Muschelkalk of Kashmir, nor are the specimens sufficiently well preserved to allow an exact determination. I consequently deemed it preferable to identify a single species only, *Worthenia Dharmænsis* Bl. with a form already described from the Muschelkalk of the Himalayas and to give a description of the most remarkable specimens without designing them to a distinct species.

Gen. Worthenia de Kon.

Worthenia Dharmaensis Blaschke.

1907. *Worthenia Dharmaensis* Blaschke, in Diener, Fauna of the Himalayan Muschelkalk, Himalayan Foss., *l.c.*, Vol. V, Pt. 2, p. 16, Pl. XI, fig. 5.

This species is very numerously represented in the Himalayan collection, but by casts only, none of which has been preserved as well as the type-specimen, described and illustrated by Blaschke. The broad and vertical lateral band, bordered by the sharp slit-keel above and by the strong basal keel below, is very conspicuous.

There is some variability in the height of the spire. In this respect none of my examples shows a close affinity with the species from Lilang, which has been described as *W. sp. ind. aff. Dharmaensis* by Blaschke (*l.c.*, p. 17, Pl. XIII, fig. 4).

Locality, number of specimens examined.—Lower Gymnites layer, Pastannah, hor. **1**, 27-8-09, 10; one mile W. of Pastannah, hor. **1**, 8-9-09, 1; Temple hill, Khrew, **2**, 17-9-09, 1.

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Gen. PROMATHILDIA Andr.

PROMATHILDIA sp. ind. (?).

Two fragments, one of two whorls and the second of one incomplete whorl, are before me. They agree entirely with the cast, which has been illustrated by Blaschke in Pl. XI, fig. 6, of my memoir on the fauna of the Himalayan Muschelkalk (*l.c.*, p. 21), and compared to *Promathildia* Andr. Both the roof-shaped apical side and the base are flatly convex and meet in an obtuse edge. The spire of this turreted shell was probably as high as in Blaschke's type from the Muschelkalk of Muth.

Locality, number of specimens examined.—Lower Gymnites beds, Pastannah, hor. **1**, 27-8-09, 2.

Gen. EUOMPHALUS Sow.

EUOMPHALUS sp. ind.

(Pl. XI, fig. 3.)

With this name I designate a cast of comparatively large size, which is the only representative of *Euomphalidæ* hitherto known among the Gasteropoda of the Indian Muschelkalk. I am well aware that, according to the present system of nomenclature, the name *Euomphalus* should not be used any more in the original wide circumscription, but the imperfect state of my materials forbids any direct identification with one of the European genera, which have been established for Triassic *Euomphalidæ* by Boehm, Kittl and Koken.

Shell widely umbilicated, depressed, discoidal, consisting of five whorls, which just touch one another. The two outer whorls of the spire have been preserved as casts without any traces of the original shelly test. Of the inner whorls a good impression has been left in the matrix, which, however, shows only the basal portion of the shell. Of the lateral and apical portions nothing is known.

The cast of the two outer whorls, the aperture of which has been broken off, has a nearly smooth surface. Its transverse section is approximately trapezoidal. Apical side of the whorls sloping in a flat plane from the sharp marginal edge to the suture. The edge is set with delicate nodes. Lateral parts flatly convex, uniting with the base in a sharply rounded angle. This lower marginal edge is not acute, like the upper one. Base flatly rounded, sloping almost as steeply towards the umbilicus as the apical side. The upper marginal edge of the outer whorls does not considerably surmount the preceding whorls in height. The spire is, consequently, very slightly concave superiorly. But the lower marginal edge is curved downwards so strongly, that the distance between this edge at the beginning and the end of the last whorl is almost equal to one-half the entire height of the latter. By this character our species is at once distinguished from *Discohelix*.

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An examination of the impression of the inner whorls shows the base to be ornamented by numerous transverse folds, which were probably raised into delicate nodes along a keel separating the base from the lateral parts. From this ornamentation, no trace of which has been noticed in the cast, we are led to suggest that the original shell was probably provided with a distinct sculpture, comparable with the sculpture in *Woehrmannia Labadeyi* D'Arch. et Vern., or in *Amphitomaria arietina* Schloth. and in *A. cirridioides* Kittl. But this probability offers, of course, no clue to the true systematic position of our species and leaves us in doubt as to its generic appurtenance to either *Woehrmannia* or *Amphitomaria* or even *Anisostoma* or a new genus of Triassic *Euomphalidæ*.

Locality, number of specimens examined.—Lower Gymnites layer, Pastannah, hor. **1**, 27-8-09, **1**.

Gen. MARMOLATELLA Kittl.

MARMOLATELLA sp. ind.

(Pl. XI, fig. 4.)

A single specimen of small dimensions, which has been somewhat distorted by pressure, in its external characters recalls the group of *Naticopsis stomatia* Stopp. (*Marmolatella* Kittl, *Jahrb. k. k. Geol. Reichsanst.*, XLIV, 1894, p. **142**). It is strongly depressed, provided with whorls, which increase rapidly. Spire small, last whorl strongly inflated. Sutures accompanied by a distinct depression. Inner lip callous, striæ of growth turned backwards.

The characters of this specimen agree so well with the leading features of *Marmolatella*, that I do not hesitate to refer it to that sub-genus of *Naticopsis*. Among the Alpine representatives of this sub-genus it might chiefly be compared to *M. applanata* Kittl (*l.c.*, p. 143, Taf. IV, figs. 6—8).

Locality, number of specimens examined.—Lower Gymnites layer, Pastannah, hor. **1**, 27-8-09, **1**.

Gen. SCURRIA Gray.

SCURRIA sp. ind.

(Pl. XI, fig. 5.)

The family of *Patellidæ* is represented in the Muschelkalk of Kashmir by two well preserved shells of moderate size, which have been referred to *Scurria*, not to *Patella*, on account of their smooth surface. But the generic determination is not quite certain, because the internal characters are not known.

The apex is situated even more excentrically than in *S. depressa* Koken (Gastropoden der Trias um Hallstatt, *Abhandl. k. k. Geol. Reichsanst.*, XVII, p. 16, Taf. I, fig. 8). Outlines of the base nearly circular. Beak slightly incurved,

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sloping very steeply anteriorly. Surface quite smooth. The absence of any circular ornamentation forbids an attempt to group our species with *Acmæa* Eschscholtz.

Locality, number of specimens examined.—Lower Gymnites layer, Pastannah, hor. **1,** 27-8-09, 1.

Class : LAMELLIBRANCHIATA.

The Lamellibranchiata are much more numerously represented in the Muschelkalk of Kashmir than in the corresponding beds of Garhwal, Kumaon and Spiti, but the difficulty of a satisfactory description is not lessened by the larger number of examples available for examination. Nearly all the specimens have been preserved in such a manner that the characters of importance can be made out only very imperfectly. Only in exceptional cases have I succeeded in making the hinge, the most important feature, visible. To this difficulty a second one is added. The majority of Lamellibranchiata, in which some of the essential characters can be made out, are of such an indifferent habit, that they might be assigned to several genera already described with nearly equal reason. This is precisely the case with the commonest shells of the Muschelkalk, which might be considered as belonging to either *Pseudomonotis* or *Lima*.

From a purely palæontological point of view it seemed to me safer to leave aside the majority of doubtful species and to describe those forms, the generic position of which can be determined with great probability, although this method excludes, of course, the possibility of giving an adequate idea of a large number of Lamellibranchiata, which actually occur in the Muschelkalk of Kashmir and which at least, in the number of individuals, are but little inferior to the Ammonoidea.

Gen. MYOPHORIA Bronn.

MYOPHORIA aff. LÆVIGATA Ziethen.

(Pl. XI, fig. 6.)

A single cast, consisting of both valves, is certainly very closely allied to this well-known species from the German Muschelkalk. It agrees very closely with the illustrations given by Goldfuss (*Petrefacta Germaniæ*, II, Taf. CXXXV, fig. 12) and Philippi (Continentale Trias, *Lethæa mesozoica*, Taf. V, fig. 9), but considerably less with that published by Quenstedt (*Petrefaktenkunde*, Taf. LXII, fig. 21), where a shell with its test entirely preserved has been figured.

My specimen is not exactly equivalve, the right valve being slightly inferior in size to the left. It is moderately inflated, but more so than typical specimens of *M. lævigata*, triangular, with rounded anterior margin and a very steep posterior dorsal area, which is bordered by an obtuse radial ridge extending from the umbo downward to the basal margin. The surface is quite smooth.

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Length and height of the shell are about 32 mm.

Notwithstanding the remarkable similarity of the present cast with *Myophoria lævigata*, an identification with this European shell is precluded by its unsatisfactory state of preservation. But even with better materials at hand for examination, I should prefer to keep the Himalayan species separate from *M. lævigata*, because it is thicker than any of the specimens from the German Muschelkalk, which I have seen. In this character it seems to hold an intermediate position between *M. lævigata* and *M. Kefersteini* Muenst. from the Raibl beds of Carinthia. It very closely resembles those rare shapes of the latter species, in which the two primary ribs are but faintly indicated and restricted to the umbonal region of the shell.

There is a great probability in favour of the suggestion that the present form from the Muschelkalk and *M. Kefersteini var. multiradiata* from the Upper Trias of Kashmir actually stand in a developmental connection.

Locality, number of specimens examined.—E. of Guryul ravine, Khunmu, hor. **7,** 11-8-08 (Ptychites layer), 1. A second fragmentary cast from a gap on the ridge N. 15° W. of Khrew, hor. **2,** 16-9-09, and a third one, which is still more fragmentary, from the Ceratites beds of Pastannah, hor. **2,** 30-8-09, probably also belong to the relationship of *Myophoria lævigata.*

Myophoria sp. ind. (Group of Carinatæ.)

(Pl. XI, fig. 7.)

The fragment of a single left valve is mentioned here on account of its remarkable size and sculpture. From a reconstruction of the original outlines a height and length of more than 40 mm. might be suggested. Posterior dorsal area sloping gently towards the posterior margin. The ridge separating it from the anterior portion of the shell is very prominent, considerably broader and higher than the radial ribs, which are very numerous and intersected by a more delicate concentric sculpture. The ornamentation of the posterior dorsal area is rather indistinct but certainly very delicate.

There are but few species to which the present one might be more particularly compared. It recalls *Myophoria decussata* Muenst. from St. Cassian (Bittner, Lamellibranchiaten der alpinen Trias, *Abhandl. k. k. Geol. Reichsanst.*, XVIII, p. 104, Taf. XII, figs. 1—8) in the development of a very prominent umbonal-posterior ridge and in the presence of a reticulate ornamentation. But the radial ribs are much stronger and the concentric lines more delicate, not taking into account the remarkable difference in the dimensions of the two species.

A second species, to which ours might be compared, is *Myophoria Kefersteini var. multiradiata* Waag. Among the numerous radiating ribs there are two, which slightly surpass in strength all the rest. In this respect its character of sculpture might represent an extreme type of the ornamentation of the Alpine form. A relationship between the two species is, moreover, indicated by their

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agreement in the outlines, and the shape and dimensions of the posterior dorsal area. But the very prominent diagonal keel or ridge and the reticulate ornamentation of my Himalayan shell make a distinction from the group of the Alpine *M. Kefersteini* an easy matter.

A third species, which shows a more distant affinity with the present one, is *M. Nathorsti* Dames (J. Boehm, Die obertriadische Fauna der Baereninsel, *Kungl. Svenska Vetensk. Akad. Handling*, Bd. XXXVII, No. 3, p. 41, Taf. V, figs. 1—3, 7—9, 17, 20, 21, 27) from the Myophoria sandstone of Mt. Misery, Bear's Island. But this Arctic species is easily distinguished from our Himalayan form by the absence of distinctly developed radial ribs—in fig. 17 delicate radial ribs are faintly indicated—and by the presence of a broad and smooth diagonal area, bordering the anterior slope of the diagonal ridge.

Taking into consideration the faint development of a concentric ornamentation, I think that our species can only be classed with the *carinatæ* (group of *M. vulgaris*), not with the *elegantes*, among the groups of Triassic *Myophoriæ*, established by Frech (*Zeitschr. Deutsch. Geol. Gesellsch.*, 1889, pp. 127—138). It will probably take its place next to *Myophoria Kefersteini* Muenst.

Locality, number of specimens examined.—Ptychites layer, gap on ridge N. 15° W. of Khrew, Vihi district, hor. **2**, 16-9-09, **1**.

Gen. Pleurophorus King.

Pleurophorus sp. ind. aff. Curionii Hau.

(Pl. XII, fig. 1.)

A single, incomplete cast, without any trace of the shelly test preserved, agrees in its external characters so closely with the typical shape of Palæozoic representatives of the genus *Pleurophorus*, that I do not hesitate in referring it to this genus.

Its outlines are rectangular, not arched, the ventral margin is straight, not sinuated, the umbo is not terminal although situated very closely to the anterior end of the hinge-line. A small lunula is developed distinctly and separated sharply from the lateral parts. All these features are characteristic of *Pleurophorus* King and forbid any attempt of grouping the present specimen with *Myoconcha* Sow.

The posterior portion of the cast, which consists of both valves, has not been preserved, but from the direction of the diagonal ridge a restoration of its original outlines might be tried. This restoration gives a total length of 55 to 60 mm. for the entire cast.

Shell strongly inequilateral, but equivalve, transversely elongated, moderately inflated. Umbo standing about 2 mm. from the anterior termination of the hinge-line. Anterior margin with sharply rounded corners. Hinge-line and ventral margin parallel. Shell divided into two unequal portions by a broadly rounded diagonal ridge. Surface of the cast quite smooth.

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No trace of the hinge apparatus has been preserved.

Dimensions.—Length of the shell	probably 55—60 mm.	
Height of the shell	22	,,
Thickness of both valves	20	,,

The fragmentary state of preservation of the present cast excludes a closer comparison with any of the Triassic species of *Pleurophorus* hitherto described, but *P. Curionii* Hauer is probably among its near allies.

Locality, number of specimens examined.—Ptychites layer, E. of Guryul ravine, Khunmu, hor. **7,** 11-8-08, 1.

Pleurophorus an Heminajas sp. ind.

(Pl. XII, fig. 2.)

This is one of the species, which seems to be without any defined and distinctive characters. It is represented by a single, imperfectly preserved cast, consisting of both valves, the right one having been considerably injured by weathering.

In its outlines it agrees pretty well with *Pleurophorus Curionii* v. Hauer (Ein Beitrag zur Kenntnis der Fauna der Raibler Schichten, *Sitzungsber. kais. Akad. Wissensch. Wien*, XXIV, p. 561, Taf. VI, figs. 7—12). It is equivalve, elongated, provided with a long, straight hinge-line, running parallel to the dorsal margin. Ventral margin convex, not sinuated. Posterior margin truncated obliquely. Umbones shifted anteriorly, but not terminal, touching one another, scarcely projecting beyond the hinge-line. A long and narrow area extends from the umbones towards the posterior termination of the hinge-line. Anteriorly a small but deep lunula is impressed below them. There is no distinct diagonal dorsal ridge developed, but from an elevated middle zone, which runs diagonally from the umbo towards the posterior end of the ventral margin, the shell is sloping gradually on both sides. The greatest inflation of the cast is situated not far from the umbones. From this place the shell gradually diminishes in thickness in a direction, following the diagonal dorsal zone backwards.

Surface of the cast smooth, but in front of the beaks a deep and sharp lunular impression or scar, followed by a broad, rounded ridge, is very remarkable. It evidently corresponds to a muscular impression in the interior of the original shell. The presence of a strong anterior muscle of similar shape has been described in the genus *Heminajas* Neum. by Waagen, especially in *H. Geyeri* L. Waagen (Die Lamellibranchiaten der Pachycardientuffe der Seiser Alm, *Abhandl. k. k. Geol. Reichsanst.*, XVIII, 2 T., p. 46, Taf. XXIX, figs. 9—13, especially fig. 13). So variable are the outlines in *Heminajas*, that some casts might easily be picked out among richer materials from the Alpine Upper Trias, which in their general shaps resemble the present specimen from Kashmir nearly as well as casts of *Pleurophorus*.

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The complete absence of impressions of the hinge forbids any decision, whether the present specimen should be attributed to *Heminajas* rather or to *Pleurophorus*.

Locality, number of specimens examined.—Ptychites layer, E. of Guryul ravine, Khunmu, hor. **7**, 11-8-09, 1.

Gen. Modiola Lam.

Modiola sp. ind.

(Pl. XII, fig. 3.)

This species, which is represented by a single cast only, is in more than one respect doubtful. The right valve is much distorted and crushed, but the left one has been tolerably well preserved. It is strongly inflated and provided with an umbo, which is rounded off, shifted towards the anterior termination of the hinge-line, but scarcely prominent beyond the small anterior wing.

Hinge-line long, uniting with the posterior margin in an obtuse angle Ventral margin slightly sinuated.

Transverse section of the valve forming a high arch, with a median crest. This character is not equally prominent, either in *Pleurophorus* King, or in *Myoconcha* Sow., two genera, which otherwise might also put in a claim for a closer comparison. This is the chief reason for my referring the present species to *Modiola*. The correctness of this determination cannot be ascertained, the decisive characters of the hinge being unknown to me.

Modiola (*Septiola*) *dreyssensiformis* Waagen (Lamellibranchiaten der Pachycardientuffe der Seiser Alm, *Abhandl. k. k. Geol. Reichsanst.*, XVIII, p. 85, Taf. XXXIII, fig. 22) is not unlike my Himalayan species, although much smaller and not emarginated ventrally. *M. carinata* Broili (Fauna der Pachycardientuffe der Seiser Alp, *Palæontographica*, L, p. 199, Taf. XXIV, figs. 5—10) and *Mytilus* (?) *alpinus* Guemb. (Woehrmann, *Jahrb. k. k. Geol. Reichsanst.*, 1889, p. 210, Taf. VIII, fig. 7) might also be compared.

Locality, number of specimens examined.—Lower Gymnites layer, Pastannah, hor. **1**, 27-8-09, 1.

Gen. Arcoptera Bittner.

Arcoptera indica nov. sp.

(Pl. XII, fig. 4.)

A single cast, consisting of both valves, agrees in its external characters with typical species of the genus *Arcoptera* Bittner (Lamellibranchiaten der alpinen Trias, *Abhandl. k. k. Geol. Reichsanst.*, XVIII, p. 126).

It is equivalve, provided with a high umbonal inflation and with a broad triangular area. An obtusely rounded ridge, which is but faintly developed,

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separates the central portion of the shell from a large posterior wing. A small anterior wing is marked off from the umbo by a deep furrow. This is exactly the shape which is met with in several of the Upper Triassic representatives of the genus *Arcoptera* from the Pachycardia beds of the Seiser Alpe, f. i. in *A. areata* Broili (Fauna der Pachycardientuffe der Seiser Alp, *Palæontographica*, L, p. 208, Taf. XXV, figs. 14—17). With this species the present one agrees in its strongly oblique shape and in the absence of a sharp corner between the posterior and ventral margins. But it is inflated more strongly, is comparatively higher, and its area is broader and shorter. It is by far the largest species of *Arcoptera* hitherto known.

Although I have not been able to examine the characters of the hinge, I think this species can be referred to *Arcoptera* with great probability. There is no other equivalve shell with similar features to which it could more advantageously be compared.

Locality, number of specimens examined.—Bed with *Rhynchonella trinodosi*, E. of Guryul ravine, Khunmu, hor. **6**, 11-8-08, **1**.

Gen. Perna Lam.

Perna sp. ind. aff. vetusta Goldf.

(Pl. XII, fig. 5.)

There is a single, strongly weathered cast, which may with great probability be referred to *Perna* Lam. It consists of both valves and seems to be very closely allied to *P. vetusta* Goldfuss (*Petrefacta Germaniæ*, II, p. 98, Taf. CVII, fig. 11) from the German Muschelkalk, so far as it is possible to judge from external features. The umbones having been partly broken off, it cannot be decided whether or not the anterior margin has been sinuated as strongly in the Himalayan as in the European species. In the oblique direction of the shell, in the broadly rounded outlines of the ventral margin and in the presence of a large posterior wing the two species agree very closely. In the broad area traces of incisions are noticed, which might correspond to ligamental grooves.

Locality, number of specimens examined.—Lower Gymnites bed, Pastannah, hor. **1**, 27-8-09, **1**.

Gen. Avicula Klein.

Avicula Pastannahensis nov. sp.

(Pl. XII, fig. 6.)

This is a large *Avicula* of a very strongly inequivalve shape. Left valve moderately inflated, provided with an umbo, which is elevated considerably above the hinge line. Right valve nearly flat.

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The beak of the left valve is very small, pointed and shifted anteriorly. Anterior wing small, not distinctly marked off. Posterior wing separated from the main portion of the shell by a deep furrow. Its outlines have, unfortunately, not been preserved.

From the direction of the concentric lines of growth the outlines of the ventral margin can be restored. They show this margin to have been regularly rounded off. Our species undoubtedly belongs to the group of *Aviculæ normales*, not of *inflectæ* (Muenst.). In the umbonal region the left valve is elevated into a narrow, rounded ridge, which gradually becomes flattened and obsolete in the direction of the posterior and ventral margins, but inclined very steeply towards the furrow separating it from the posterior wing.

Right valve almost perfectly flat. Area very low, linear. Anterior wing rudimentary, posterior one not marked off distinctly.

Although my only specimen has not been particularly well preserved, I have distinguished it by applying a proper specific designation, on account of its remarkable features of specific importance. As far as it is possible to judge from its external features, it is a true *Avicula*, not *Gervilleia*, notwithstanding its great similarity to some representatives of the latter genus. There are several species of Triassic *Aviculæ*, which agree with the present form in their strong resemblance to Triassic *Gervilleiæ*, especially to such as belong to the group of *G. Meriani* Stopp. *Avicula Foulloni* Bittner (Triaspetrefacten von Balia in Kleinasien, *Jahrb. k. k. Geol. Reichsanst.*, XLI, 1891, p. 111, Taf. II, fig. 2) from the Upper Trias of Balia (Asia Minor), *A.* (*Meleagrina*) *Tundræ* Teller (Die Pelecypodenfauna von Werchojansk in Ostsibirien, *Mem. Acad. impér. des sciences, St. Pétersbourg*, VII sér., 1886, T. XXXIII, p. 133, Pl. XIX, fig. 9) from the Upper Triassic beds with *Pseudomonotis ochotica* in Siberia, *A. Homfrayi* Gabb (in Whitney, *Geol. Surv. of California, 1864, Palæontology*, Vol. I, p. 29, Pl. VI, fig. 26) may be mentioned here, but the two last named species have been so incompletely preserved that any closer comparison is excluded. Of *A. Foulloni* only the left valve is as yet known, but this shows, indeed, a remarkable similarity to the corresponding valve in *A. Pastannahensis*.

A. Pastannahensis is certainly a new species, which is not closely allied to any of the congeneric forms from the Muschelkalk nor from younger Triassic strata of the Alpine region.

Locality, number of specimens examined.—Lower Gymnites layer, Pastannah, hor. 1, 27-8-09, 1.

Gen. Lima Brug.

Lima sp. ind. (Group of L. Striata Schloth.)

(Pl. XII, fig. 12.)

A right valve of a small, ribbed *Lima*, which evidently belongs to the group of *L. striata* Schloth. (Goldfuss, *Petrefacta Germaniæ*, II, p. 75, Taf. C, fig. 1).

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Among Himalayan *Limæ* it seems to be nearly related to the small *Lima* from the beds with *Halobia comata* in Painkhanda, which has been described and illustrated by Bittner (Himalayan Foss., *l.c.*, Vol. III, Pt. 2, Trias Brachiopoda and Lamellibranchiata, p. 50, Pl. VII, fig. 20). Its anterior side slopes more steeply than the posterior one. Of the anterior ear nothing is seen, but of the posterior wing traces have been preserved.

The species is of a broader shape than *Lima striata* and inflated less strongly. Ribs occurring to the number of forty, marked with equal strength on both sides of the shell, separated by intervals of the same width as themselves. In the anterior portion of the cast some strong concentric folds are noticed.

From Bittner's Himalayan species ours is readily distinguished by the larger number of ribs and by the presence of a concentric sculpture. *L. Telleri* Bittner (Lamellibranchiaten der alpinen Trias, *Abhandl. k. k. Geol. Reichsanst.*, XVIII, p. 194, Taf. XXIV, fig. 4) agrees with it in its outlines and in the number of ribs, but has a comparatively large anterior wing.

Locality, number of specimens examined.—Lower Gymnites layer, Pastannah, hor. **1, 27-8-09, 1.**

LIMA sp. ind. aff. SUBPUNCTATA d'Orb.

(Pl. XII, figs. 9, 10, 11.)

This is by far the most common species of Lamellibranchiata in the Muschelkalk of Kashmir. Some slabs of rock, consisting almost entirely of this shell, numerous single valves and two specimens are before me, in which both valves attached to one another in their normal position, have been preserved. But curiously enough, I have not succeeded in discovering one single specimen with the wings preserved. My determination is, consequently, not perfectly safe, although there are some strong reasons in favour of it.

The absence of distinctly developed external wings might induce us to venture on an identification with *Mysidioptera* Sal. But with such an identification the apical angle of the present species would scarcely agree. *Pseudomonotis* Beyr. might also be taken into consideration and it must be conceded that right valves remind us very strongly of some of the smooth species of this genus from the Lower Trias, but an identification with *Pseudomonotis* is prohibited by the equivalve character of the shell, as is evident from the specimens illustrated in Pl. XII, figs. 9 and 10. An identification of our species with *Lima* is supported by the discovery of a true *Lima* in the Upper Trias of Kashmir, which resembles the present form very closely in its outlines and ornamentation, but is provided with two distinctly developed though very small wings.

Shell equivalve, moderately or very little inequilateral, little or moderately inflated. In both characters the range of variation is rather considerable. The specimen illustrated in fig. 10 is an extreme type, being remarkably inequilateral

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on one hand and comparatively flat on the other. The specimen illustrated in fig. 12 is conspicuous by its nearly equilateral shape and strong inflation.

The surface of the shell is covered with very numerous and delicate radiating striæ, which are intersected by a system of still more numerous and delicate concentric lines of growth. The topmost layer of the shelly test has not been preserved in any of the specimens examined. I am, therefore, not able to say whether or not the punctate structure of the radial lines has been developed; this is characteristic of *Lima subpunctata* d'Orbigny (Prodrome, I, p. 200), but is restricted to the external layer of the shell.

Our species cannot be identified with *L. subpunctata* from the beds of St. Cassian, although it is certainly nearly allied to it. The wings, if such have been present at all, must have been considerably smaller, otherwise some rudimentary traces at least ought to have been preserved in one of the numerous examples at hand for examination. There is also a remarkable difference in size. The Alpine species is always of comparatively small dimensions, whereas in my specimen illustrated in fig. 9 the following measurements have been found :—

Height of the shell	32 mm.
Length „ „	31 „
Thickness of both valves	13·5 „

In its outlines and sculpture the present species agrees very well with the impression of a left valve from the Middle Trias of Con-Tung (Tongking), which has been referred to *Lima subpunctata* d'Orb. by Mansuy (Contribution a la Carte géol. de l'Indochine, *Service des Mines, Hanoi-Haiphong*, 1908, *Paléontologie*, p. 66, Pl. XVII, fig. 4), but in this impression a distinct posterior wing is noticed.

The species, which is, perhaps, allied most nearly to the present one, is *Lima* (*Plagiostoma*) *mysica* Bittner (Triaspetrefacten von Balia in Kleinasien, *Jahrb. k. k. Geol. Reichsanst.*, XLI, 1891, p. 109, Taf. II, fig. 1), which is provided with wings of extremely small size, but differs from the Himalayan form by the absence of a distinct sculpture.

Locality, number of specimens examined.—Ptychites layer, gap on ridge N. 15° W. of Khrew, hor. **2,** 16-9-09, 40; Lam, Patarkul valley, hor. **3,** 16-8-09, **12**; Ptychites layer, E. of Guryul ravine, Khunmu, hor. **7,** 11-8-09, 2; Lower Gymnites layer, Pastannah, hor. **1,** 27-8-09, 1.

Gen. Mysidioptera Sal.

Mysidioptera eximia nov. sp.

(Pl. XI, fig. 8.)

This is one of the largest species of the genus *Mysidioptera* A tolerably well preserved, although somewhat incomplete left valve and a fragmentary right

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valve are before me. I consider the left valve, which has been illustrated, as the type of this species.

It is very moderately inflated, of nearly equal height and length, and of obliquely oval outlines. The border between the umbonal portion of the shell and the lunular depression has been satisfactorily preserved. As far as we may judge from the direction of the lines of growth, the hinge-line was not considerably shorter than the ventral margin. The anterior margin has been entirely broken off.

The typical characters of the hinge are clearly visible. The broad area is cut off from the lunular depression by a sharp edge running obliquely backward. Ligamental groove strongly oblique, distinctly defined, but reduced to a sharp incision.

Surface of the shelly test nearly smooth, ornamented with numerous and delicate striæ of growth, but outlines devoid of any radial sculpture.

In its dimensions and outlines the present species might be compared with *M. incurvostriata* Woehrmann (Fauna der Carditaschichten, *Jahrb. k. k. Geol. Reichsanst.*, 1889, p. 202, Taf. VI, figs. 10, 11), especially with the large example illustrated by Broili (Fauna der Pachycardientuffe der Seiser Alp, *Palæontographica*, L, 1903, Pl. XX, figs. 17, 18), but the absence of any radiating ornamentation distinguishes it at once from the overwhelming majority of Alpine *Mysidiopteræ*. There is no species, to which it seems to be more closely allied.

It is perhaps worth mentioning that this species is the largest *Mysidioptera* hitherto known, notwithstanding its low stratigraphical position. In Europe the geologically oldest representatives of the genus are of Muschelkalk age, but it attains a rich development only in the Ladinic and Carnic stages. Now the presence of a species of so large dimensions in the Himalayan Muschelkalk is not in accordance with a rule of evolution advocated by Dépéret and by several American palæontologists who expect to find the largest representatives of a genus invariably near the end, not at the beginning, of its developmental career.

Locality, number of specimens examined.—Gymnites layer, one mile W. of Pastannah, hor. **1,** 8-9-09, **1**; Pastannah, hor. **3,** 3-9-09, **1**.

Mysidioptera sp. ind.

(Pl. XII, fig. 13.)

Mysidioptera eximia is not the only species of this genus, which is known to me from the Muschelkalk of Kashmir. There are several valves of *Limidæ* before me, which from their external characters, especially from the long and straight hinge-line, are referable to *Mysidioptera*.

My examples are single valves only. The best preserved among them has been illustrated in fig. 13. It is a left valve with a perfectly smooth surface closely resembling some of the Alpine species from the limestone of Esino, as

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described and illustrated by Bittner. It can, however, not be identified with any of them, because its anterior margin does not project beyond the apex although in the rest of its external features there is a very close agreement with *M. Cainalli* Stoppani (Pétrifications d'Esino, *Paléontologie Lombarde*, p. 97, Pl. XX, fig. 6) or with the still more oblique species, which has been referred to *M. aff. Cainalli* by Bittner (Lamellibranchiaten der alpinen Trias, *Abhandl. k. k. Geol. Reichsanst.*, XVIII, Taf. XX, fig. 16).

The absence of any radial ornamentation in this specimen is not due to any corrosion by weathering, the concentric lines of growth being distinctly marked, thus proving the shelly test to have remained uninjured.

Locality, number of specimens examined.—Lower Muschelkalk, Pastannah, hor. **1**, 3-9-09, 1.

Remarks.—*Mysidiopteræ* of this indifferent habit are found in the Alpine Trias in all horizons from the Lower Muschelkalk (Brachiopod-bearing limestone of Recoaro) up to the base of the Noric stage.

Gen. PECTEN Klein.

PECTEN sp. ind.

(Pl. XII, fig. 14.)

A small *Pecten*, of which single (left?) valves only are available for examination. They are moderately convex, of nearly circular outlines, and provided with an apical angle, which is a little less than 90 degrees. The specimen illustrated is the only one in which traces of the wings have been preserved. They are of small size and not distinctly marked off from the marginal edges of the shell. If this valve is supposed to be a left one, it is the posterior wing which must have been considerably smaller and smooth. The left or anterior wing, traces of which only have been preserved, was distinctly ribbed, thus participating of the sculpture of the marginal region of the shell.

The ornamentation consists of about thirty principal ribs, which are acutely rounded and separated by intervals twice as broad as themselves. Along the ventral margin a very delicate secondary rib is regularly intercalated between two principal ribs. But this intercalation of secondary ribs has not been noticed along the anterior and posterior margins of the shell.

In this ornamentation our species agrees exactly with *Pecten Albertii* Goldfuss (*Petrefacta Germaniæ*, pp. 42, 138, Taf. LXXXIX, fig. 1; CXX, fig. 6). The indistinct separation of the wings from the shell and the larger size of the left (anterior) wing are also features which might be advocated in favour of a close affinity of our Himalayan form with the German species. But my materials are too scanty to enable me to give a decided opinion on this question.

Pecten Albertii has been proved to belong to the sub-genus *Velopecten* by Philippi (Beitræge zur Morphologie u. Phylogenie der Lamellibranchier, *Zeitschr.*

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Deutsch. Geol. Ges., L, 1898, p. 608). Of the species from St. Cassian with alternating ribs, which have been described by Bittner and referred to *Velopecten* by Philippi, there is none, which appears to be allied more closely to the present one.

Locality, number of specimens examined.—Ptychites layer, spur N.N.E. of Khunmu, Vihi district, hor. **7,** 11-8-08, 1; Ptychites layer, gap on ridge N. 15° W. of Khrew, Vihi district, hor. **2,** 16-9-09, 2.

Gen. Anomia L.

Anomia Triadica nov. sp.

(Pl. XII, figs. 15, 16.)

Although I am well aware that true representatives of *Anomia* have not as yet been found in strata older than the Jurassic system, I cannot help referring the present species to this genus.

The small specimen illustrated in fig. 15 has all the external features of generic importance, which are characteristic of *Anomia*, especially the thin shell, which splits off easily in small lamellæ, the rounded outlines and the peculiar position of the apex, which is situated inside the margins of the shell. The specimen illustrated in fig. 16 is flattened and probably represents a right valve, but the peculiar characters of this valve, namely, the sinus or perforation serving as a passage for the byssus, cannot be observed, the apical portion having been unfortunately broken off in this valve.

The reference to *Anomia* must therefore be based on external features only, but those features are in my opinion developed with sufficient clearness to warrant a safe identification.

Locality, number of specimens examined.—Lam, Patarkul valley, hor. **3¾,** 16-8-09, 1; Ptychites layer, gap. on ridge N. 15° W. of Khrew, Vihi district, hor. **2,** 16-9-09, 3.

Gen. Anodontophora Cossm.

Anodontophora Patarkulensis nov. sp.

(Pl. XII, fig. 7.)

This is a typical representative of the genus *Anodontophora* Cossman. A well preserved cast, with parts of the shelly test adhering to it, is before me showing a great resemblance to the common fossil of the Alpine Lower Trias *A. fassænsis* Wissm. and to *A. Griesbachi* Bittner (Himalayan Foss., *Palæontol. Ind.*, ser. XV, Vol. III, Pt. 2, Trias Brachiopoda and Lamellibranchiata, p. 60, Pl. VIII, figs. 14—16) from the Upper Trias of the central Himalayas.

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Shell inequivalve and inequilateral. Posterior portion considerably shorter, obliquely sub-truncate. Umbones incurved very slightly towards the longer anterior side, shifted from the middle considerably towards the posterior side. Umbo of the left valve standing higher than that of the opposite valve. No distinct lunula developed.

Shelly test very thin, covered with numerous and extremely delicate concentric striæ of growth, which do, however, not increase in number or strength towards the pallial margin.

The species of the genus *Anodontophora* being all very similar to one another, a distinction must needs be based on subordinate differences, the importance of which is stated very differently by different authors. From *A. Griesbachi* our species is easily distinguished by the different position of its umbo, which in the Noric species is almost medianly situated or even shifted anteriorly. The typical form of *A. fassænsis* Wissm. is more slender and its posterior margin is sharply rounded, not sub-truncate. This difference is evident from a comparison of my illustration with that of a typical example of the Alpine species from the Werfen beds of the Bakony, which has been published by G. v. Arthaber in *Lethæa mesozoica* (Alpine Trias des Mediterrangebietes, Taf. XXXIV, fig. 10). This form, it is true, differs considerably from the specimen from the German Muschelkalk, which has been referred to *A. fassænsis* by Alberti (Ueberblick über die Trias, Stuttgart, 1864, p. 137, Taf. III, fig. 8) by its more compressed shape, but the median position of its umbo furnishes us here with a good character of distinction from our Himalayan shell. The range of variation attributed to the European species by Tommasi (La fauna del Trias inferiore nel versante meridionale delle Alpi, *Palæontogr. Ital.*, Vol. I, 1895, p. 62, Pl. IV, fig. 2) is still wider. Taken in the wide circumscription, which has been advocated by the Italian author, *A. fassænsis* might even include our Himalayan shell, although the bad state of preservation of Tommasi's specimens is a very serious obstacle to any safe identification.

Locality, number of specimens examined.—Lam, Patarkul valley, hor. **3**, 16-8-09, **1**.

Anodontophora sp. ind.

(Pl. XII, fig. 8.)

A second species of *Anodontophora* may be mentioned here, a form which is distinguished from the preceding one by its very long hinge-line and nearly rectangular shape. But the state of preservation of the only cast available for examination is so fragmentary, that its reference to *Anodontophora* is not quite certain, although the slightly inequivalve shape, the absence of any pallial sinus and the firm attachment of the two valves along the entire ventral margin are strong reasons in its favour.

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Locality, number of specimens examined.—Ptychites layer, gap on ridge N. 15° W. of Khrew, hor. **2,** 16-9-09, 1.

Gen. LITHOPHAGUS Meg.

LITHOPHAGUS (?) sp. ind.

(Pl. XII, fig. 18.)

A small fragment, which is mentioned here on account of its probably belonging to a boring shell. Anterior and umbonal portions greatly thickened. Shell inequivalve, with corroded umbones. The valves were probably gaping along the pallial margin. Surface covered with concentric striæ of growth.

The state of preservation of this fragment precludes a closer comparison with European species of the genus *Lithophagus*, to which it probably belongs.

Locality, number of specimens examined.—Lower Gymnites layer, Pastannah, hor. **1,** 27-8-09, 1.

Gen. ind. sp. ind.

(Pl. XII, fig. 17.)

I wish to mention a cast illustrated in Pl. XII, fig. 17, because it unites some features characteristic of *Trigonodus* Sandberg. on one hand and of *Pachycardia* Hau. on the other. Only the umbonal portions of the two valves have been preserved. They are firmly attached to one another. Beaks strongly prosogyrate, adjoining a small lunula, which is not distinctly marked off.

In its general shape this cast resembles *Trigonodus* more closely than *Pachycardia.* But no species of *Trigonodus* is known to me, in which the valves are so strongly inflated. In this respect the cast more nearly approaches *Pachycardia.* The difference in the position of the beaks is also a character, in which it agrees with the latter genus, the beak of the right valve being shifted anteriorly beyond the left umbo. But the absence of any distinct depression behind the umbones excludes an identification with *Pachycardia.*

Locality, number of specimens examined.—Ptychites layer, gap on ridge N. 15° W. of Khrew, hor. **2,** 16-9-09, 1.

Class : BRACHIOPODA.

The brachiopod fauna of the Muschelkalk of Kashmir is very rich in individuals, the shales of the hor. **4,** 15-9-09, having yielded some hundreds of examples

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of *Rhynchonella*, but the number of species is extremely limited. There are, moreover, very few species, which have been met with in different horizons and at different localities.

Gen. SPIRIFERINA d'Orb.

SPIRIFERINA STRACHEYI Salter.

(Pl. XII, fig. 19.)

1865. *Spiriferina Stracheyi* Salter, Palæontology of Niti, Calcutta, p. 72, Pl. IX, fig. 13.
1899. *S. Stracheyi* Bittner, Himalayan Foss., *Palæont. Ind.*, ser. XV, Vol. III, Pt. 2, Trias Brachiopoda and Lamellibranchiata, p. 18, Pl. IV, figs. 3—14.
1907. *S. Stracheyi* Diener, *ibidem*, Vol. V, Pt. 2, Fauna of the Himalayan Muschelkalk, p. 2, Pl. I, fig. 6.

The majority of specimens available for examination are distorted and injured by weathering. No example has been found in a better state of preservation than the one illustrated. This is the largest specimen obtained by C. S. Middlemiss. It shows all the distinctive features of the species in a satisfactory manner, namely, the high area, the widely expanding sinus, a mesial dorsal fold, which is undivided and bordered on either side by deep furrows, and traces of wing-shaped extensions of the lateral parts along the hinge-line. Six ribs are counted on each side of the mesial sinus or fold.

The majority of examples are young individuals of small dimensions, which, consequently, very closely resemble the European *Spiriferina fragilis* Schloth., from which they cannot be easily separated. This remark applies particularly to the specimens from Khrew, which neither show pointed wings nor a rapidly widening sinus of their ventral valves. A character, however, which may always serve as a feature of distinction from *S. fragilis*, is the considerable height of the area. I have not seen a single individual of *S. Stracheyi* with an area so low as it has been figured in all the types of *S. fragilis* illustrated by Bittner (Brachiopoden der alpinen Trias, *Abhandl. k. k. Geol. Reichsanst.*, XIV, Taf. XXXV, figs. 2—5). Nor is the area in *S. Stracheyi* incurved, as in the European species, but always nearly level. On the strength of those characters even young examples of *S. Stracheyi*, however similar they may be otherwise to *S. fragilis*, can therefore always be distinguished from the leading form of the European Muschelkalk.

Locality, number of specimens examined.—Brachiopod bed, E. of Guryul ravine, hor. **6,** 16-8-09, 4; ridge N. 15° W. of Khrew, hor. **4,** 15-9-09, 10.

Remarks.—The specimens from Khrew have been referred provisionally to *S. Griesbachi* Bittn. or *S. Haueri* Suess by C. S. Middlemiss (*Records. Geol. Surv. of India*, XL, Pt. 3, p. 250). But they have certainly nothing in common with those two Upper Triassic species. From *S. Griesbachi* they can be at once distinguished by the absence of any median rib in the ventral sinus, from *S. Haueri* by their differently shaped area, which is flat and high, whereas it is lower and strongly incurved in the latter species.

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SPIRIFERINA (MENTZELIA) cf. KOEVESKALLIENSIS Suess.

1865. *Spiriferina Koeveskalliensis* Suess, *Verhandl. k. k. Geol. Reichsanst.*, p. 245.
1866. *S. Spitiensis* Stoliczka, *Mem. Geol. Surv. of India*, V, p. 39, Pl. III, fig. 5.
1873. *S. Koeveskalliensis* Suess, in Boekh, *Geologische Verhaeltnisse des suedlichen Bakony*, p. 175, Taf. XI, figs. 22, 23.
1899. *S. Koeveskalliensis* Bittner, Himalayan Foss., *Pal. Ind.*, ser. XV, Vol. III, Pt. 2, Trias Brachiopoda and Lamellibranchiata, p. 21, Pl. IV, figs. 15, 16. For a complete list of European synonyms the reader is referred to this memoir.
1907. *S. Koeveskalliensis* Diener, *ibidem*, Vol. V, Pt. 2, Fauna of the Himalayan Muschelkalk, p. 2.

A fairly well preserved cast of *Spiriferina Koeveskalliensis* Suess, with a few remnants of its shelly test adhering, agrees in its outlines and dimensions very closely with the *var. Spitiensis* Stol., as illustrated in fig. **16** by Bittner. The thick beak has been partly broken off. Its area is low, narrow and distinctly incurved. The delicate ribbing of the surface is clearly seen in the frontal region.

Locality, number of specimens examined.—Lower Gymnites layer, top bed, Pastannah, hor. **1, 27-8-09, 1.**

Gen. DIELASMA King.

DIELASMA HIMALAYANUM Bittner.

1899. *Terebratula (Dielasma) Himalayana* Bittner, Himalayan Foss., *Pal. Ind.*, ser. XV, Vol. III, Pt. 2, Trias Brachiopoda and Lamellibranchiata, p. 25, Pl. V, figs. 1—8, 10, 11.
1907. *Dielasma Himalayanum* Diener, *ibidem*, Vol. V, Pt. 2, Fauna of the Himalayan Muschelkalk, p. 5.

There are several examples of the narrow, elongated form of *Dielasma Himalayanum* before me, all of small size, with a smooth surface and with a very low frontal lobe. The strong dental plates in the umbonal region are distinctly visible on the cast, thus warranting a safe identification of my specimens with *Dielasma*.

Locality, number of specimens examined.—Brachiopod bed, E. of Guryul ravine, hor. **6, 11-8-09, 6.**

Gen. RHYNCHONELLA Fisch.

RHYNCHONELLA TRINODOSI Bittn.

(Pl. XII, figs. 20, 21, 22.)

1890. *Rhynchonella trinodosi* Bittner, Brachiopoden der alpinen Trias, *Abhandl. k. k. Geol. Reichsanst.*, XIV, p. 13, Taf. XXXII, figs. 17—35.
1907. *Rh. trinodosi* Diener, Himalayan Foss., *l.c.*, Vol. V, Pt. 2, Fauna of the Himalayan Muschelkalk, p. 6, Pl. I, figs. 1, 2.

In the crumbling shales of the Muschelkalk of Khrew, hor. **4,** 15-9-09, some hundreds of small Brachiopods were collected by C. S. Middlemiss (*Records, Geol. Surv. of India*, XL, p. 250), the majority of which he referred to *Rh. cf.*

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trinodosi Bittn. This identification has been fully confirmed by an examination of his rich materials.

It should be noted that the discovery of this widespread species of the Alpine Muschelkalk was not altogether unanticipated. Bittner in his memoir on the Brachiopoda and Lamellibranchiata of the Himalayan Trias (Him. Foss., Vol. III, Pt. 2, p. 14, Pl. II, fig. 10) mentions a specimen from the Muschelkalk of Muth, Spiti, obtained by C. L. Griesbach, which he compares with *Rh. trinodosi*, although it could not be identified with the typical form of that species. Later on two specimens from the Muschelkalk of Kalapani, Byans, collected by F. H. Smith, have been referred to *Rh. trinodosi* by myself.

Among the materials before me the typical form of *Rh. trinodosi* with one rib in the sinus and two ribs in the mesial fold of the dorsal valve and with the sculpture restricted to the front and marginal region of the shell only, is comparatively rare. The specimen illustrated in fig. 20 is a good representative of this typical form. It agrees closely with the deeply sinuated type, which has been illustrated by Bittner in Pl. XXXII, fig. 26. The majority of Himalayan examples are provided with three ribs in the mesial fold of the dorsal valve and two ribs in the corresponding ventral sinus. They agree with the type illustrated in fig. 28 by Bittner, which in the Alpine Muschelkalk is met with less frequently than the shape with a smaller number of ribs. There is a variety among the Himalayan examples which even surpasses this type in the number of ribs. It has been illustrated in fig. 22 and shows three ribs in the sinus of the larger valve, corresponding to four ribs in the mesial fold of the dorsal valve.

Another character, in which the Himalayan species shows a wider range of variation than the Alpine one, is the extent of the ornamentation. In the Alpine form this is, as a rule, restricted to the frontal and marginal regions of the shell but the visceral portion remains entirely smooth. Specimens agreeing entirely in this respect with the Alpine type are in a small minority among the Himalayan shells. In the majority the ribs can be traced for a longer distance as being distinctly raised above the adjacent shell-surface, and in some exceptional cases the ribs extend from the margins to the very beaks. Such examples exhibit a certain resemblance with some varieties of *Rh. decurtata* Gir., especially with the *var. dalmatina* Bittner (*l.c.*, Pl. XXXII, fig. 13), but their intimate connection with typical shapes of *Rh. trinodosi* precludes any suggestion of referring them to any other group of Triassic *Rhynchonellæ*.

The inflation of the shell is also of a very variable nature. Flat and thick shapes occur mixed together rather indiscriminately among the materials from Khrew. A few specimens from the Guryul ravine, which are all provided with two ribs in the ventral sinus and three in the corresponding mesial fold of the dorsal valve, are inflated more strongly than the type illustrated by Bittner in fig. 28, with which they otherwise agree in their dimensions, outlines and sculpture.

A character, which is common to all my specimens, is the distinct separation of the wings from the middle portion in both valves. It is a good feature of distinction in the group of *Rh. trinodosi*.

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Locality, number of specimens examined.—Bed with *Rh. trinodosi*, ridge N. 15° W. of Khrew, Vihi district, hor. **4,** 15-9-09, about 50; E. of Guryul ravine, hor. **6,** 11-8-08, **3.**

RHYNCHONELLA MUTABILIS Stol.

1865. *Rhynchonella mutabilis* Stoliczka, *Mem. Geol. Surv. of India*, Vol. V, Pt. 1, p. 40, Pl. III, figs. 5—9.
1899. *Rh. mutabilis* Bittner, Himalayan Foss., *Pal. Ind.*, ser. XV, Vol. III, Pt. 2, Trias Brachiopoda and Lamellibranchiata, p. 15, Pl. II, figs. 11—13.
1907. *Rh. mutabilis* Diener, *ibidem*, Vol. V, Pt. 2, Fauna of the Himalayan Muschelkalk, p. 6.

A *Rhynchonella* of large size, resembling *Rh. trinodosi* very closely in its outlines, but provided with a comparatively less prominent sculpture. Two sharp ribs in the sinus of the ventral valve correspond with three ribs in the median fold of the opposite valve. The specimen agrees with Stoliczka's type-specimen of *Rh. mutabilis* illustrated in fig. **12** of Bittner's memoir.

Locality, number of specimens examined.—Lam, Patarkul valley, hor. **4,** 16-8-09, **1.**

RHYNCHONELLA LAMANA nov. sp.

(Pl. XIII, figs. **1—4.**)

This is the most interesting species among the Brachiopoda from the Muschelkalk of Kashmir. Its typical shape is represented by the specimens illustrated in figs. **1** and **2**, to which the majority of examples from Lam and Pastannah belong. It resembles *Rh. acuminata* Mart. from the Carboniferous rocks of Europe so closely, that we might, indeed, be induced to consider it to be a late straggler of the sub-genus *Pugnax*, Hall et Clarke, from the younger Palæozoic.

The typical form is trigonal in its outlines, or rather cordiform, if seen from the front, a little longer than wide, and of moderate (fig. **1**) or considerable (fig. **2**) thickness. Dorsal valve elevated into an acuminate or highly rounded median fold, from which the lateral portions slope rapidly on either side, without any interruption. To this acuminate mesial fold a deeply excavated, concave sinus corresponds in the ventral valve. Originating in the umbonal region, it actually extends from the terminations of the wings across the entire width of the valve. In the front it is either regularly curved or prolonged into an acute, cuneiform extremity. The beak, which has been well preserved in the specimens illustrated in figs. **3** and **4**, is small, incurved, projecting very little beyond an extremely low and incurved deltidial area. It is pierced by a small foramen, placed either exactly at its extremity or a little below it.

In the typical form the surface is either smooth or ornamented by rudimentary ribs, which are restricted to the frontal region of the sinus and corresponding fold. But as a rule, see do not find a trace of a rib on the lateral portion of the

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valves. This character distinguishes our species at once from the Jurassic group of *Rh. loxia* Fisch., with which it agrees otherwise in the development of an acuminate and high dorsal fold.

That our species is no straggler from the Palæozoic sub-genus *Pugnax*, but is the offspring from an entirely different ancestor, notwithstanding its close resemblance to *Rh. acuminata* Mart. (*vide* Th. Davidson, *Brit. Foss. Brach.*, Vol. II, Pal. Soc., London, 1858-63, p. 93, Pl. XX, figs. 1—13; XXI, figs. 1—20), is proved by the presence of numerous varieties, some of them marking transitional stages between *Rh. Lamana* and the Triassic group of *Rh. trinodosi*. Such shapes have been illustrated in figs. 3 and 4.

In the ventral valves the sinus is not sharpened or pointed at its extremity, but uniformly rounded, and the acuminate elevation of the dorsal fold is replaced by a more gentle and broader curve. The ventral sinus shows two short, prominent ribs, which correspond to three acute ribs in the frontal part of the dorsal fold. But the most important change in the shape is marked by the development of indistinct furrows, separating the mesial region of the valves from the wings. Thus the affinity with the trilobate shells of the group of *Rh. trinodosi* becomes sufficiently prominent to exclude any suggestion of *Rh. Lamana* belonging actually to the relationship of the Palæozoic sub-genus *Pugnax*. It only needs a glance at Bittner's illustrations of *Rh. mutabilis* Stol. to show us the nearest ally of our species. The example of *Rh. Lamana* illustrated in Pl. XIII, fig. 4, holds an intermediate position between the typical form of the present species and *Rh. mutabilis*. If *Rh. mutabilis* were to become smoother and developed a high frontal lobe, no longer distinctly marked off from the lateral portions of the shell, it must, indeed, assume a shape agreeing exactly with that which is found in *Rh. Lamana*.

Rh. Lamana and *Rh. mutabilis* Stol. probably stand in a similar, close connection as *Rh. Laucana* Bittner (Himalayan Foss., *l.c.*, Vol. III, Pt. 2, Trias Brachiopoda and Lamellibranchiata, p. 44, Pl. VIII, figs. 5, 6) stands to *Rh. regilla* Bittner (Brachiopoden der alpinen Trias, *Abhandl. k. k. Geol. Reichsanst.*, XIV, p. 226, Taf. XIII, figs. 23, 24), whose frontal tongue is broadly vaulted, whereas in *Rh. Laucana* a high and narrow frontal lobe is developed.

It is a well-known fact that among some genera of Brachiopoda, in which a persistence through many geological periods is combined with a tendency to strong variation, but with a limited number of possibilities to form new shapes, old types are eventually repeated in younger epochs, without being their direct offsprings. In this way the Palæozoic type of *Uncinulus* reappears in the group of *Rh. plicatilis* of Cretaceous age, or the Triassic type of *Halorella* in the group of *Rh. Astieriana* of Upper Jurassic age (*vide* Diener, Palæontologie und Abstammungslehre, Leipzig, 1910, p. 115). As little as *Rh. Astieriana* is a direct descendant from *Halorella*, can *Rh. Lamana* be brought into any direct phylogenetic connection with *Pugnax*. It is a somewhat aberrant offspring of the group of *Rh. trinodosi* Bittn. and its remarkable similarity with *Pugnax* is

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only one of the many cases of convergency, which are so often met with in the developmental history of animals.

	Fig. 1.	Fig. 2.	Fig. 4.
Dimensions.—Entire length } of the	21 mm.	16 mm.	16·5 mm.
„ breadth } shell	18 „	14 „	16 „
Length of the dorsal valve . . .	20 „	15 „	15 „
Thickness of both valves . . .	13 „	14 „	11 „

The internal structure of this species is known to me in rough outlines only, my materials not being suitably preserved for an elaboration of the critical features of the hinge.

Locality, number of specimens examined.—Lam, Patarkul valley, hor. **4,** 16-8-09, 10; Pastannah, hor. **1,** 12-9-09, 30.

III.—FOSSILS FROM THE UPPER TRIAS.

Class: Cephalopoda.

The few fragments of Cephalopoda occurring in the Upper Trias of Kashmir are preserved so imperfectly that I must abstain from a closer inquiry into them. A large Nautiloid shell, with strongly inflated whorls and a narrow umbilicus (C. S. Middlemiss, *Records, Geol. Surv. of India*, Vol. XL, 1910, p. 256), and several sections of Ammonites, whose generic position could not be ascertained, have been found in hor. **4,** 8-8-08, E. of Guryul ravine, Khunmu, and hor. **2,** 26-8-09, Narastan.

Class: Lamellibranchiata.

Gen. Myophoria Bronn.

Myophoria cf. Kefersteini Münst. var.

Multiradiata Waag.

(Pl. XIII, figs. 5—9.)

1907. *Myophoria Kefersteini* Münst. *var. multiradiata* L. Waagen, Lamellibranchiaten der Pachycardientuffe der Seiser Alp, *Abhandl. k. k. Geol. Reichsanst.*, XVIII, p. 70, Taf. XXXI, figs. 6—8.

From the Upper Trias of Khunmu numerous examples of right and left valves were obtained which on the strength of a close comparison with casts of *Myophoria Kefersteini* Münst. appear to be most nearly allied to this well-known Alpine species.

The best illustrations of the Alpine *M. Kefersteini*, a leading fossil of the Raibl beds of the Carnic stage, have been published by A. Boué (*Mém. Soc. géol. de France*, T. II, Pt. 1, 1835, Pl. IV, fig. 8), F. v. Hauer (Ein Beitrag z. Kenntnis der Fauna der Raibler Schichten, *Sitzber. kais. Akad. d. Wissensch. Wien*, XXIV, 1857, Taf. IV, figs. 1—3), Parona (Fauna Raibliana di Lombardia, Pavia, 1889,

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Pl. V, fig. 5), Broili (Fauna der Pachycardientuffe der Seiser Alp, *Palæontographica*, L, 1904, Taf. XXVII, figs. 34—36), G. v. Arthaber (Alpine Trias, in *Lethæa mesozoica*, Bd. I, Taf. XL, fig. 3), L. Waagen (*l.c.*, Taf. XXX, figs. 6—16; XXXI, figs. 1—13). An exhaustive description of the species is found in L. Waagen's memoir.

A left valve, which approaches most nearly the typical form of *M. Kefersteini* (fig. 7), is longer than high. The thickness of both valves was probably equal to one-half of the length of the left valve. A strong, acutely rounded diagonal ridge runs from the umbo downwards to the posterior corner of the ventral margin. In its acute shape this ridge agrees better with the corresponding ridge in the right valve of typical specimens of *M. Kefersteini* from Raibl. In front of this ridge two sharp ribs are noticed dividing the shell into three areas of nearly equal width. The two ribs are distinctly developed in the umbonal region only and even there the anterior rib is very delicate. This character is seen in exceptional cases in Alpine examples of *M. Kefersteini*, in which the anterior rib is reduced in strength to a thin edge. The faint development of the transverse ribs would not be a sufficient reason for excluding the Himalayan species from the range of variations of *M. Kefersteini*.

In the marginal region the posterior rib, which in the middle of the shell entirely disappears, again becomes visible, although it does not reach its former strength. It is accompanied all along the ventral margin by a number of short, radial delicate lines.

The posterior dorsal area joins the diagonal ridge in a very steep angle, which amounts to 90 degrees in the umbonal region. This area is crossed by two radial lines, which are equal in strength to the anterior rib in front of the diagonal ridge.

This specimen represents an exceptional type among my Himalayan shells, both in the faint development of the main ribs and in the reduction of accessory radial folds, which are reduced to delicate lines in the narrow region along the ventral margin. The typical form of my Himalayan *Myophoria* is distinguished by the presence of an irregular number of accessory radiating ribs, which are intercalated in front of the second main rib. They occur in both valves and are of nearly equal strength. In this respect the majority of my specimens agree very closely with *M. Kefersteini var. multiradiata* Waag., especially with the type from Lesno brdo (Carniola) illustrated in fig. 6. In a small number of specimens even the smooth zone between the diagonal keel and the posterior rib is ornamented with delicate radiating lines, which in strength are far inferior to the ribs and form a sculptural element of secondary order only.

Occasionally, concentric lines of growth are developed more strongly than in the typical form of the Alpine species (fig. 8). The acute shape of the diagonal ridge, as noticed in my specimen, fig. 7, is also an exception to the rule. In the majority of examples this ridge is broadly rounded in the left valve, exactly as in the Alpine type.

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The shelly test has been but rarely preserved and then in small fragments only. It is comparatively thin, shows a distinct concentric ornamentation, and exhibits the radiating sculpture more prominently than in the cast.

In its outlines my Himalayan species varies only within narrow limits. There are broader and longer forms and also the shape of the small lobe in the ventral margin in front of the diagonal keel varies somewhat. But both valves are always longer than high, and the posterior dorsal area is comparatively steep.

Our Himalayan species strikingly recalls *M. Kefersteini var. multiradiata* Waag. It is barely distinguishable from that well-known Alpine shell. Some of my examples almost certainly fall within its range of variation. If nevertheless I have referred them to the Alpine species with some reservation, the reason for this is to be sought in the comparatively scanty materials hitherto representing the Indian form, of which neither complete specimens, consisting of both valves attached to each other, nor the structure of the hinge are known to me.

Dr. L. Waagen, our best authority on the Lamellibranchiata of the Alpine Upper Trias, who has examined more than one hundred examples of *M. Kefersteini*, after a careful inspection of my materials agrees with me in referring the Himalayan form to *M. Kefersteini* as *cf.* only, because in the majority of my examples the area included between the diagonal keel and the following primary rib is slightly depressed, a feature which has not been noticed by him in the Alypine *M. Kefersteini.*

Locality, number of specimens examined.—Pastannah, hor. **4,** 30-8-09, **12**; hor. **6,** 30-8-09, **3.**

Myophoria Middlemissii nov. sp.

(Pl. XIII, figs. 10, 11, 12.)

This new species is a good representative of the group of *Myophoria harpa* Muenst. Its nearest ally is probably *M. acuticostata* Broili (Die Fauna der Pachycardientuffe der Seiser Alp, *Palæontographia*, L, 1903, p. 216, Taf. XXVII, figs. 24—26), from which it is, however, easily distinguished by the small number of radiating ribs.

In its external shape *M. Middlemissii* recalls *M. harpa* Muenst (Bittner, Lamellibranchiaten der alpinen Trias, *Abhandl. k. k. Geol. Reichsanst.*, XVIII, p. 91, Taf. XII, figs. 15—19). It is moderately or even strongly inflated, of equal length and height or even higher than long, rounded anteriorly and along the ventral margin, but bordered by approximately straight lines posteriorly and in the region opposite the ventral margin. Beak moderately developed, shifted considerably anteriorly. Anterior lunula small, indistinctly defined.

Surface of the shell ornamented by four or five radial ribs, three of them originating in the apex. Those three ribs are high and acute, but not serrated, as in *M. harpa.* The posterior rib corresponds to the diagonal keel of *Myophoriæ*, but its character as a true keel is not as prominent as in other groups of the genus,

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because the posterior dorsal area is not separated from the anterior portion of the shell by a steep angle. In this respect my examples are, however, subjected to considerable variation. In the type illustrated in fig. **11** this angle is much steeper than in the specimen illustrated in fig. **10**. The third specimen illustrated in fig. **12** holds an intermediate position between them. A low and delicate rib, which cannot be traced as far as the umbo, is situated close to the long and almost straight hinge-line. The width of the posterior dorsal area is always greater than the space between the posterior rib, which corresponds to the diagonal keel of *Myophoriæ*, and the next anterior rib. The space between this second prominent rib and the third is considerably smaller, measuring only two-third parts of the space between the posterior and central rib. In the majority of specimens a fifth delicate rib is noticed in front of the anterior prominent rib.

Specimens, in which the shelly test has been preserved, exhibit a surface, which is not nearly smooth, as in casts, but ornamented by numerous and very delicate concentric lines of growth.

Although left and right valves are known to me, I have not found a complete specimen among my materials, consisting of both valves attached to each other in their original position. Nothing can, consequently, be said of the relative dimensions of the two valves. As far as can be seen from the examination of single valves, they agree very closely in their outlines, convexity and sculpture.

Locality, number of specimens examined.—Pastannah, hor. **3,** 30-8-09, 3; hor. **4,** 30-8-09, 3; hor. **6,** 30-8-09, 4.

MYOPHORIA sp. ind. aff. WHATELEYÆ v. Buch.

(Pl. XIII, figs. **13—14**.)

Two left valves from the Myophoria-limestone of Pastannah recall *Myophoria Whateleyæ* v. Buch (*Bull. Soc. géol. de France*, 1844-45, 2e ser., Vol. II, p. 348, Pl. IX, figs. 1—3).

The Himalayan form is undoubtedly very closely allied to this Alpine species, if taken in the narrow circumscription proposed by A. Bittner (Lamellibranchiaten der alpinen Trias, *Abhandl. k. k. Geol. Reichsanst.*, XVIII, p. 100, Taf. XI, figs. 18—21), but I dare not venture on an identification, even with the reservation of adding a *cf.* regarding my scanty materials and the absence of right valves.

In the outlines a difference might perhaps be found in the somewhat less elongated shape and in the position of the umbo in my Himalayan valves. In *M. Whateleyæ* the umbo is shifted a little more anteriorly. Both species agree, however, in the steep slope of the anterior portion and in the character of their ornamentation. In both of my examples the diagonal carina is the most important element of sculpture. It is elevated into a steeply rounded ridge, which in strength considerably surpasses all other radiating ribs. The steep posterior area is nearly smooth, with the exception of an indistinct rib, which separates the small escutcheon from this area. Lunula not clearly seen. Antecarinal

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depression wider than the following intercostal depressions. Radial ribs diminishing in strength from the first rib bordering the antecarinal depression towards the anterior margin.

In my smaller specimen six ribs have been counted in front of the diagonal keel. In my larger example this number is considerably larger. The number of ribs is, however, subject to a remarkable variation in all the members of the *Whateleyæ* group. The tendency of the ribs to diminish in strength when approaching the pallial margin, which has been mentioned in *M. Whateleyæ* by L. v. Buch and Bittner, has not been noticed in my Himalayan shells. On the contrary it is only in the marginal zone of my smaller specimen that delicate secondary ribs make their appearance in the broad antecarinal depression. In my larger example those secondary ribs or lines can be traced from the ventral margin up to the umbonal convexity. In the European *M. Whateleyæ* secondary ribs are never developed as distinctly as in this shell.

A complete agreement between the two species is found in the absence of any concentric sculpture.

A species, to which the present one also appears to be very closely related, is *M. omanica* Diener (Note on some fossils from the sedimentary rocks of Oman, *Records Geol. Surv. of India*, Vol. XXXVI, p. 156, Pl. XXIV, figs. 1, 2) from Elphinstone inlet. The Arabian form is probably a little higher and more strongly inflated. Its sculpture is more prominent and the radial ribs are crossed by a concentric ornamentation. But in any case it is to *M. omanica* and to *M. Whateleyæ* that our species from Kashmir is nearest in relationship.

Locality, number of specimens examined.—Myophoria limestone, Pastannah, hor. **4,** 30-8-09, 1; hor. **6,** 30-8-09, **1.**

Gen. Trigonodus Sandb.

Trigonodus sp. ind.

(Pl. XIII, fig. 18.)

A left valve imbedded in the tough matrix, thus rendering the interior invisible, is very similar in its external shape to some Upper Triassic species of *Trigonodus* Sandb. with a faintly developed diagonal keel and a small umbo. The height, as measured from the beak to the ventral margin, is but very little inferior to the maximal height. In this respect our shell agrees with the group of *T. problematicus* Klipst., not with *T. Rablensis* Gredl., whereas it approaches the latter in the faintly developed umbo. Anterior margin projecting considerably beyond the beak, but without any emargination. Carina indistinct, replaced by a geniculation, from which the shell slopes towards the posterior margin.

In its outlines the present valve resembles *T. carniolicus* Bittn. (Waagen, Lamellibranchiaten der Pachycardientuffe der Seiser Alm, *Abhandl. k. k. Geol. Reichsanst.*, XVIII, p. 30, Taf. XXVIII, figs. 3—5), but it is flatter and less distinctly carinate.

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Ornamentation consisting of numerous and very delicate lines of growth only.

Dimensions.—Length of the valve	17	mm.
Height measured from the beak to the ventral margin	11·5	,,
Maximum height	11	,,
Thickness of the valve	4	,,

Locality, number of specimens examined.—Myophoria limestone, Pastannah, hor. **6,** 30-8-09, **1.**

TRIGONODUS nov. sp. ind.

Two left valves of large size, resembling *Trigonodus Bittneri* Waagen (Lam. d. Pachycardientuffe der Seiser Alm, *Abhandl. k. k. Geol. Reichsanst.*, XVIII, p. 27, Taf. XXVII, figs. 10—13) or *T. problematicus* Klipst. (F. v. Hauer, Beitrag z. Kenntnis der Fauna der Raibler Schichten, *Sitzungsber. k. Akad. Wissensch., Wien,* XXIV, 1857, p. 545, Taf. I, figs. 7—9) in their external shape, especially in the development of a prosogyrate umbo. But the diagonal keel is indicated less distinctly and our valves are higher and flatter than in the European shells mentioned. The concentric sculpture is clearly marked, although less strongly than in *T. costatus* Woehrmann (Fauna der Raibler Schichten vom Schlernplateau, *Zeitschr. Deutsch. Geol. Gesellsch.*, 1892, p. 186, Taf. VII, figs. 9—12).

This species is certainly new, no *Trigonodus* being known to me, with similarly flattened valves.

Locality, number of specimens examined.—Myophoria beds Pastannah, hor. **4,** 30-8-09, **2.**

Remarks.—Single valves of similar outlines, but in an even more indifferent state, have been collected in the Upper Trias of Lain, Patarkul valley, hor. **5,** 16-8-09. They can, however, be referred to *Trigonodus* with still greater reservation. It must always be borne in mind that not in one single case is the hinge, the most important feature of those shells, known to me.

Gen. HŒRNESIA Laube.

HŒRNESIA BHAVANI nov. sp.

(Pl. XIII, figs. 15—17.)

Cassianella Beyr. and *Hœrnesia* Laube are allied so closely that their distinction is very difficult, if one has to deal with species whose relationship with the typical forms of both genera is rather distant. The only distinctive feature, on which we may rely according to Bittner, is the position of the deep furrow or depression, which in *Cassianella* separates the anterior wing from the umbonal portion of the shell, whereas in *Hœrnesia* it passes across the latter. If this character is considered as a safe basis for a distinction of the two genera, the present species must be grouped with *Hœrnesia*, not with *Cassianella*, although in

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its general shape it recalls, perhaps, more closely some representatives of the latter genus than the prototype of *Hœrnesia*, namely, *H. Joannis Austriæ* Klipst.

My species is of large size and quite smooth. It occurs associated with *Myophoria Kefersteini var. multiradiata* and with *M. Middlemissii* in the Upper Trias of Pastannah. But all my specimens are, unfortunately, in an imperfect state of preservation. They are casts of left valves, with a few traces of the shelly test adhering. In all of them the larger portion of the anterior wing has been broken off. The posterior wing has been completely preserved in a specimen from the Upper Trias of Khrew (fig. 17). It is large, broadly triangular and pointed.

The left valve is strongly oblique and considerably incurved. The most remarkable character is the deep depression, which is bordered on either side by a sharp rim and marks off the anterior wing from the middle portion of the shell. It divides the umbo into two parts of unequal size. In this character our species is therefore a typical *Hœrnesia*. The depression is strongly oblique and directed backwards considerably. The back of the umbo is narrow and not greatly elevated above the anterior wing. Posterior slope steep and elongated, imparting to the central portion of the cast a moderately inflated shape. It is distinctly marked off from the *Cassianella*-shaped, flattened back, but not bordered by any rib nor keel.

Surface of the cast quite smooth. Shelly test ornamented with delicate concentric lines of growth.

There is only one species among the Alpine *Hœrnesiæ*, to which the present one could be compared. This is *H. Sturi var. austriaca* Bittner (Lamellibranchiaten der alpinen Trias, *l.c.*, p. 84, Taf. X, fig. 5). In this species the umbo is also divided by a sharp depression, which is bordered by a distinct rim on either side, and the wings are pointed, not obtuse. But in the European species the shell is less strongly oblique and smaller, the depression is wider, the posterior wing does not project beyond the posterior shell-margin, and the surface of the test exhibits a delicate radial sculpture. These differences are sufficient to prove the specific independence of *H. Bhavani*, which differs distinctly from all known Triassic species of Laube's genus.

Locality, number of specimens examined.—Myophoria limestone, Pastannah, hor. **4,** 30-8-09, 3; hor. **6,** 30-8-09, 4; Spur N.W. of Khrew, hor. **3,** 16-9-09, 1.

Gen. Gervilleia Defr.

Gervilleia sp. ind.

I have a fairly well preserved left valve of large size from the Upper Trias of Lam, Patarkul valley, hor. **1,** 20-8-09. It differs from the *Aviculæ* of the St. Cassian and Raibl beds by its strongly inflated shell and by the absence of any distinct demarcation between the middle portion of the shell and the posterior wing. In both of these characters it agrees with *Gervilleia* Defr. much

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more closely than even with such exceptional shapes of *Avicula* as are remarkable for their strong resemblance to Triassic *Gervilleiæ*, as *A. Foulloni* Bittner (*Jahrb. k. k. Geol. Reichsanst.*, XLI, 1891, p. 111, Taf. III, fig. 2) or *A. Pastannahensis* Dien. (*vide infra*, Pl. XII, fig. 6). Unfortunately, the tough matrix does not allow of the exposure of the hinge. Thus a more minute investigation into its true relationship is impracticable.

In its shape the present species seems to be most closely related to some forms of *Gervilleia*, which have been described by Schauroth (*Zeitschr. Deutsch. Geol. Ges.*, IX, 1857) and Philippi (Die Fauna des unteren Trigonodusdolomits vom Huehnerfeld bei Schwieberdingen, etc., *Jahreshefte Ver. f. vaterlænd. Naturkunde in Wuertemberg*, 1898). It especially recalls *G. Goldfussi* Stromb. (Philippi, *l.c.*, p. 157, Taf. IV, figs. 6—7), but is considerably larger and narrower. There is no distinct edge developed between the middle portion of the shell and the large posterior wing. Posterior margin of the latter obtuse, not pointed, as in *G. alata* Phil. Anterior wing small, separated from the umbonal region by an indistinct furrow. Ornamentation restricted to numerous, very delicate concentric lines of growth.

Among the *Gervilleiæ* of the Alpine Upper Trias there is no species to which the present one shows any closer affinity.

Gen. Pseudomonotis Beyr.

Pseudomonotis sp. ind.

From the Myophoria limestone of Pastannah, hor. **4,** 30-8-09, there are several single valves, which in their outlines resemble the group of *Pseudomonotis Telleri* Bittn. They are of large size, slightly inequilateral, and ornamented only by delicate concentric lines of growth. As it has been found impossible to expose the apical region and wings in any of the specimens available, no further comparison can be entered into.

Gen. Lima Brug.

Lima cf. subpunctata D'Orb.

(Pl. XIII, fig. 19.)

1841. *Lima punctata* Muenster, *Beitræge zur Petrefaktenkunde*, IV, p. 73, Taf. VI, fig. 29.
1843. *L. punctata* A. v. Klipstein, *Beitræge zur geol. Kenntn. der oestlichen Alpen*, I, p. 248, Taf. XVI, fig. 6.
1849. *L. subpunctata* D'Orbigny, *Prodrome*, I, p. 200.
1865. *L. subpunctata* Laube, Fauna der Schichten von St. Cassian. *Denkschr. kais. Akad. Wiss. Wien*, math. nat. Kl., XXV, p. 72, Taf. XX, fig. 1.
1895. *L. subpunctata* Salomon, Geologische und palæontologische Studien über die Marmolata, *Palæontographica*, XLII, p. 143, Taf. IV, fig. 9.
1895. *L. subpunctata* Bittner, Lamellibranchiaten der alpinen Trias, *Abhandl. k. k. Geol. Reichsanst.*, XVIII, p. 170, Taf. XXI, figs. 19, 20, 22—24.

It has already been pointed out in my description of the Lamellibranchiata from the Muschelkalk of Kashmir that a smooth species of *Lima* has been dis-

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covered among the materials from the Upper Trias, which was proved to belong to this genus by the presence of distinctly developed, though very small, wings. This species is certainly not identical with the *Lima* from the Muschelkalk. It is always of much smaller dimensions. In this respect and in all its external characters it agrees very closely with the shapes of *L. subpunctata* from the Alpine Muschelkalk, which have been figured by Bittner, especially with the specimen illustrated in fig. 23 of his memoir quoted above.

All my specimens are moderately or very slightly inequilateral, not considerably inflated, and higher than long. Examples, in which these proportions have been reversed and which resemble Bittner's type-specimen from St. Cassian illustrated in fig. 19, have not been met with.

The peculiar ornamentation of the test, as described by Muenster and Laube, has been not noticed in my Himalayan examples, which, as a rule, are nearly smooth, exhibiting only a very indistinct and delicate concentric sculpture.

Locality, number of specimens examined.—Myophoria limestone, Pastannah, hor. **3,** 30-8-09, **1**; hor. **4,** 30-8-09, **2**.

Gen. MYSIDIOPTERA Sal.

MYSIDIOPTERA div. sp. ind.

The majority of smooth shells from the Upper Trias of Pastannah belongs to the genera *Lima*, *Mysidioptera* and *Pecten*. The slabs of rock, in which the single valves are included, form a true Lumachelle, thus rendering the exposure of complete valves a very difficult matter. In many cases I found it impossible to verify the generic position of incomplete valves. From the large number of examples such only could be picked out as have the outlines sufficiently well preserved for a safe determination of the genus. Among them the genus *Mysidioptera* is represented by two species, both of them in a rather poor state of preservation and represented by right valves only.

One of them is a flat form of small size, with a terminal apex and with a very small lunular emargination. Hinge-line elongated. Shell strongly oblique, thus recalling *M. avivulæformis* Broili (Fauna der Pachycardientuffe der Seiser Alp, *Palæontographica*, L, 1903, p. 185, Taf. XXII, fig. 5). But as the only specimen available for examination is not completely preserved, it would be useless to carry the comparison further.

The second species recalls by its shape *M. globosa* Broili (*l.c.*, p. 188, Taf. XXII, fig. 16). It has the umbonal portion of the right valve strongly inflated and has a deep, excavated lunula. The surface is quite smooth.

Locality, number of specimens examined.—Myophoria limestone, Pastannah, hor. **4—6,** 30-8-09, 5.

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Gen. PECTEN Klein.

PECTEN (CHLAMYS) MIDDLEMISSII nov. sp.

(Pl. XIII, fig. 20.)

Only single valves are available for examination. I consider them as left valves, on account of the remarkable difference in size of the two wings, the larger one corresponding to the anterior wing. Apical angle acute, less than 90°. Shell flattened, with a distinct furrow following the direction of the margin from the apex to the ventro-posterior corner. Hinge-line angular. Border of the large anterior wing horizontal, margin of the small anterior ear directed obliquely downwards. Surface of the test nearly smooth. By means of a lens very delicate striæ of growth could be noticed, which are intersected by indistinct radiating lines.

This species cannot be compared with the smooth *Pectines* from St. Cassian, which from the shape of their wings must be classed with *Entolium* (*E. subdemissum* Muenst., *E. Zitteli* Woehrm.), but is probably one of the rare Triassic representatives of *Chlamys* Bolt. Its nearest ally is, perhaps, *Chlamys tubulifer* Muenst. (Bittner, Lamellibranchiaten der alpinen Trias, *Abhandl. k. k. Geol. Reichsanst.*, XVIII, p. 158, Taf. XIX, figs. 8—15), notwithstanding the remarkable difference in their sculpture. It seems to belong to those smooth shapes of *Chlamys*, which in the Lower Lias play a more important part. If *Pecten varius* L. is taken as prototype of *Chlamys*, in accordance with Fischer (Manuel de Conchyliologie, III, p. 944), our species possesses all the distinctive features of this group as enumerated by Philippi (*Zeitschr. Deutsch. Geol. Ges.*, LII, 1900, p. 85), an acute apical angle, a large anterior and a very small posterior wing and a shell which is higher than long.

Locality, number of specimens examined.—Myophoria limestone, Pastannah, hor. **3,** 30-8-09, 2; hor. **6,** 30-8-09, 2.

PECTEN (VELOPECTEN) sp. ind.

A large species of *Pecten*, of which, however, a complete valve is not available. Wings only partially preserved. Shell of nearly equal height and length, with regularly rounded outlines and moderately convex. Apical angle acute. From the apex numerous ribs originate, which become gradually obsolete in the direction towards the pallial margin. In the intercostal depressions between the primary ribs, secondary ribs are irregularly intercalated, but there is never more than one rib intercalated between two primary ones.

The species must undoubtedly be placed in the group of *P. subalternans* D'Orb., without, however, being identical with any of the numerous species which have been described by Bittner, Salomon, Waagen and Philippi.

Locality, number of specimens examined.—Myophoria limestone, Pastannah, hor. **6,** 30-8-09, 5.

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Gen. PLEUROPHORUS King.

PLEUROPHORUS cf. CURIONII v. Hau.

(Pl. XIII, fig. 21.)

1857. *Myoconcha Curionii* v. Hauer, Ein Beitrag zur Kenntnis der Fauna der Raibler Schichten, *Sitzungsber. kais. Akad. Wissensch. Wien*, XXIV, p. 561, Taf. VI, figs. 7-12.
1889. *M. Curionii* Parona, Studio monographico della fauna Raibliana di Lombardia, Pavia, p. 131, Pl. XII, figs. 1—7.
1903. *M. Curionii* Broili, Fauna der Pachycardientuffe der Seiser Alp, *Palæontographica*, L. p. 196. Taf. XXIII, figs. 23, 24.
1907. *Pleurophorus Curionii* L. Waagen, Lamellibranchiaten der Pachycardientuffe der Seiser Alp, *Abhandl. k. k. Geol. Reichsanst.*, XVIII, p. 156, Taf. XXXII, figs. 6-13.

A single cast of a right valve agrees very closely in its shape with *Pleurophorus Curionii* Hau. from the Alpine Raibl beds. It is elongated, broadening out slightly towards the posterior margin. Ventral margin flatly convex, without any trace of a sinus; nor is there any trace of a depression of the shell, which might correspond to a ventral sinus. Apex shifted anteriorly but not terminal. An indistinct diagonal ridge, which is obtusely rounded, runs from the beak to the ventro-posterior corner. Surface of the cast quite smooth.

The present cast is referred here to *P. Curionii* as *cf.*, because I have not succeeded in making the hinge visible and to record the provisional identification of the Himalayan and Alpine species.

Locality, number of specimens examined.—Lam, Patarkul valley, hor. **5**, 16-8-09, **1**.

Class: BRACHIOPODA.

Gen. SPIRIFERINA Sow.

SPIRIFERINA STRACHEYI Salt.

(Pl. XIII, figs. 22—24.)

For references the description of this species in the preceding chapter should be consulted.

From the Upper Trias of several localities in Kashmir Mr. C. S. Middlemiss has enumerated two species of Brachiopoda, which he compared to *Spiriferina Stracheyi* Salt. and *S. Haueri* Suess.

All the specimens mentioned by C. S. Middlemiss under the above names are before me. The overwhelming majority are referable to *Spiriferina Stracheyi* Salt., the well-known leading fossil of the Himalayan Muschelkalk. The adult examples from Lam, Patarkul valley, hor. **1**, 16-8-09, which have been illustrated in figs. **22** and **23**, are specifically identical with it. They possess the strikingly wing-like extensions of the hinge-line, which impart to *S. Stracheyi* its characteristic habit that so vividly recalls the Palæozoic *Spiriferidæ* and is not known in any European form of Triassic age. In all other features those examples, together with a large number of others from the same locality and horizon,

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agree also exactly with the type of *S. Stracheyi*, especially in the high and almost level area, in the development of a smooth and rapidly widening sinus and of a small number (six to seven) of undivided lateral ribs.

The specimens from Khrew and Narastan are in a less satisfactory state of preservation. But some of them show the distinctive features of the species sufficiently well to allow of a safe determination. It is chiefly on the strength of a comparison with the examples from the Muschelkalk of the Guryul ravine, hor. **6,** 11-8-09, and from the ridge N. 15° W. of Khrew, hor. **4,** 15-9-09, that I can venture on an identification with *S. Stracheyi*. The specimens from the Upper Trias cannot be separated from those obtained from the Muschelkalk, as they are not essentially distinguishable from them in any respect.

One of the largest examples from Khrew, hor. **1,** 15-9-09, illustrated in fig. 24, is remarkable for its comparatively narrow and strongly produced ventral sinus.

The presence of *S. Stracheyi*, the leading fossil of the Himalayan Muschelkalk, in beds of Upper Triassic age, although rather unexpected, is a convincing proof of the wide vertical distribution of several species of Triassic *Spiriferinæ*. In my memoir on the Ladinic, Carnic and Noric faunæ of Spiti (Himalayan Foss., Vol. V, Pt. 3, p. 150) I have laid a special stress on the presence of some remarkable Brachiopoda in the grey beds of Julic age, which exhibit a closer affinity to forms from the Muschelkalk than from Upper Triassic stages. To those species—*Mentzelia Mentzelii* Dunk., *Rhynchonella Freshfieldi*, a descendant of the *trinodosi* group, *Spiriferina orophila*, the nearest ally to *S. avarica* Bittn., *Dielasma julicum* Bittn.—*S. Stracheyi* must now be added.

Locality, number of specimens examined.—Spur N.W. of Khrew, hor. **1,** 15-9-09, 2; hor. **2,** 15-9-09, 2; hor. **3,** 16-9-09, 5; Narastan, hor. **1,** 25-8-09, 6; hor. **3,** 25-8-09, 3; Lam, Patarkul valley, hor. **1,** 16-8-09, 7; Wean spur, Vihi district, hor. **1,** 14-8-08, 2.

SPIRIFERINA sp. ind. aff. LILANGENSIS Stol.

(Pl. XIII, fig. 25.)

The only specimen among the numerous examples referred to *Spiriferina cf. Haueri* Suess by C. S. Middlemiss, which must be separated from *Sp. Stracheyi* Salt., is easily distinguished from the latter species by its short hinge-line. The greatest width of the shell does not coincide with the hinge-line, but is situated considerably in front of it.

My specimen seems to hold a position intermediate between the European *S. fragilis* Schloth. and *S. Lilangensis* Stoliczka (*Mem. Geol. Surv. of India*, Vol. V, p. 38, Pl. III, fig. 4). It agrees with the latter chiefly in the conspicuous coarse graining of its shelly test, which has been mentioned as a feature of specific importance in *S. Lilangensis* by Bittner (Himalayan Foss., *l.c.*, Vol. III, Pt. 2, p. 20, Pl. IV, fig. 2), and in the comparatively greater number of lateral ribs. On

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the other hand it approaches *S. fragilis* more closely in the development of its deep and broadly expanding sinus, which in the umbonal region is even acute, not rounded at the bottom.

My specimen not being absolutely identical with either of those two species from the Muschelkalk, it seemed to me advisable to keep it provisionally separate. But it is certainly very nearly allied to both of them and must, consequently, be added to the types of Brachiopoda in the Upper Trias of Kashmir, which bear a close affinity to Muschelkalk types.

Locality, number of specimens examined.– Spur N.W. of Khrew, hor. **3, 16-9-09, 1.**

Remarks.—Among the specimens referred to *Spiriferina Haueri* Suess as *cf.* by C. S. Middlemiss, which I have examined, this is the only one which could be more closely compared to that species. But *S. Haueri* has the area more strongly incurved and the sculpture less distinctly defined. Nor does its shelly test show the coarse graining, which is conspicuous in *S. Lilangensis.*

SPIRIFERINA (MENTZELIA) cf. MENTZELII Dunk.

1851. *Spiriferina Mentzelii* Dunker, *Palæontographica*, I, p. 287, Taf. XXXIV, figs. 17, 18, 19.
For further synonyms consult A. Bittner, Brachiopoden der alpinen Trias, *Abhandl. k. k. Geol. Reichsanst.*, XIV, p. 22, and my memoir on the fauna of the Himalayan Muschelkalk, Himalayan Foss., Vol. V, Pt. 2, p. 3.
1908. *Spiriferina (Mentzelia) Mentzelii* Diener, Ladinic, Carnic and Noric faunæ of Spiti, *ibidem*, Vol. V, Pt. 3, p. 57, Pl. IX, fig. 4.

From the same horizon, from which the above described *Spiriferina sp. aff. Lilangensis* Stol. has been obtained by C. S. Middlemiss, a specimen of a smooth *Spiriferina* has been collected, whose dorsal valve has been somewhat crushed, but which otherwise, especially in its outlines, has been sufficiently well preserved to justify its provisional reference to *Mentzelia Mentzelii* Dunk. In its shape it agrees exactly with some of the small and flat examples from the Alpine Muschelkalk, in which the sinus has been reduced to a shallow depression.

Locality, number of specimens examined.—Spur N.W. of Khrew, hor. **3, 16-9-09, 1.**

Sub-gen. DIELASMA King.

DIELASMA JULICUM Bittn.

(Pl. XIII, fig. **27.**)

1890. *Terebratula julica* Bittner, Brachiopoden der alpinen Trias, *Abhandl. k. k. Geol. Reichsanst.*, XIV, pp. 125, 158, Taf. IV, figs. 14, 15; XXXIX, figs. 15, 16.
1908. *Dielasma julicum* Diener, *Palæontol. Indica*, ser. XV, Himalayan Foss., Vol. V, Pt. 3, Ladinic, Carnic and Noric faunæ of Spiti, p. 59, Pl. IX, fig. 14. For further synonyms this memoir should be consulted.

This species is represented in the Upper Trias of Pastannah by several, fairly well preserved examples. The specimen illustrated agrees in its shape, especially in the biplicate character of the frontal lobe, very closely with Bittner's

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type from Raibl, illustrated in Pl. IV, fig. 14, of the "Brachiopoden der alpinen Trias." It is of equal length and width and considerably smaller than my Himalayan type from the grey beds of Muth.

In one specimen I have been able to find the strong dental plates of the ventral valve, which are proof of the correctness of our reference to the sub-genus *Dielasma*.

Locality, number of specimens examined.—Myophoria limestone, Pastannah, hor. **6,** 30-8-09, 5.

Gen. RHYNCHONELLA Fisch.

RHYNCHONELLA TRINODOSI var. FRESHFIELDI Dien.

(Pl. XIII, fig. 26.)

1908. *Rhynchonella Freshfieldi* Diener, Himalayan Foss., *Palæont. Indica*, ser. XV, Vol. V, Pt. 3, Ladinic, Carnic and Noric faunæ of Spiti, p. 50, Pl. X, figs. 1, 2.

If the only specimen available for examination had been obtained from a bed of undoubted Muschelkalk age, I should not hesitate for a moment to unreservedly include it with *Rhynchonella trinodosi* Bittn.

It resembles very closely such forms of the *trinodosi* group as are provided with two ribs in the sinus of the ventral valve and with three ribs in the corresponding frontal lobe of the opposite valve. It is of a comparatively globose shape and a little larger than my Himalayan examples from the Muschelkalk of Khrew. In both of these characters it agrees with *Rh. Freshfieldi* from the grey beds of Muth.

Rh. Freshfieldi has been separated from *Rh. trinodosi*, to which it is very closely allied, on account of the larger number of ribs, the more strongly inflated shape, and the steeper slope of the lateral parts from the ribs bordering the mesial sinus of the larger valve. Among those three features of distinction, the last is certainly the only one to which a specific value might be accorded. The number of ribs has not been found to be a constant character in the Himalayan representatives of *Rh. trinodosi*, shapes with either one or two ribs in the sinus of the ventral valve occurring in the Brachiopod bed of Khrew.

Whether a specific or a varietal importance should be attributed to those small differences, by which *Rh. Freshfieldi* might be distinguished from *Rh. trinodosi*, is a matter of personal taste only. As has been remarked in my memoir quoted above, the two forms are so closely allied to each other, that the Indian species could be regarded equally well as a variety of *Rh. trinodosi* only. The discovery of the true *Rh. trinodosi* in Kashmir, where it exhibits a range of variation even wider than in the Alpine Muschelkalk, induces me to include the present form among its varieties.

Locality, number of specimens examined.—Spur N.W. of Khrew, hor. **3, 16-9-09, 1.**

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RHYNCHONELLA LAMANA Dien.

Typical forms of this interesting species, which resembles *Pugnax acuminata* Mart., although in reality included in the group of *Rh. trinodosi* Bittn., have been obtained from Narastan, hor. **1,** 25-8-09, where they are associated with a *Spiriferina,* probably referable to *S. Stracheyi* Salt., but too poorly preserved to allow of a safe determination.

FAUNISTIC AND STRATIGRAPHICAL RESULTS.

My examination of the collection of Triassic fossils made by Mr. C. S. Middlemiss during his survey of the Vihi district in Kashmir in the years 1908 and 1909 has fully confirmed the geological results of this survey, summarized in his very interesting paper: " A revision of the Silurian-Trias sequence in Kashmir," forming Pt. 3 of Vol. XL of the *Records of the Geological Survey of India.*

Evidence has been obtained of the presence of faunæ of the Lower, Middle and Upper Trias.

I.—LOWER TRIAS.

The limestones and shales of the Lower Trias, which are about 300 feet in thickness, include at least two, perhaps even three, different faunæ.

The lower fauna is contained in the Ophiceras layer of Pastannah, hor. **1,** 5-9-09. It consists of the following species :—

Xenodiscus Himalayanus Griesb.
,, *cf. Lissarensis* Dien.
,, *æquicostatus nov. sp.*
,, *Salomonii nov. sp.*
,, *Althothæ nov. sp.*
,, *cf. ellipticus* Dien.
,, *Comptonii nov. sp.*
,, *cf. rotula* Waag.
,, *cf. ophioneus* Waag.
,, *cf. Sitala* Dien.
Ophiceras Sakuntala Dien.
,, *ptychodes* Dien.
,, *demissum* Dien.
,, *Chamunda* Dien.
,, *cf. gibbosum* Griesb.
,, *cf. tibeticum* Griesb.
,, *cf. medium* Griesb.
Vishnuites Pralambha Dien.
Pseudosageceras clavisellatum nov. sp.
Orthoceras sp. ind.
Pseudomonotis (*Claraia*) *Griesbachi* Bittn.
,, (,,) *aurita* Hau.
,, (,,) *Painkhandana* Bittn.
,, (*Eumorphotis*) *tenuistriata* Bittn.
,, (,,) *multiformis* Bittn.
,, (,,) *sp. ind. aff. austriaca* Bittn.

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One more species, *Inyoites kashmiricus nov. sp.*, should perhaps be added to this list, but it could not be ascertained whether the only example, by which it is represented in the collection, was found *in situ* or in loose blocks, together with *Hungarites Middlemissii* Dien. (hor. ×, 4-9-09).

This is the fauna of the lowest member of the Himalayan Trias in the classical sections of the Shalshal cliff, the Otoceras beds. Its facies is exactly the same as in Painkhanda. It consists of a clear, dark, blue-grey limestone, which frequently forms a true lumachelle of the shells of Ammonites, occasionally associated with single valves of *Pseudomonotis*. Specimens of rock from the Otoceras beds of the Shalshal cliff and from the Ophiceras layer of Pastannah resemble each other so closely that they could barely be distinguished without consulting the accompanying labels.

The fauna of the Ophiceras layer of Pastannah agrees with that of the Otoceras beds of the Shalshal cliff and of the Ophiceras bed in Spiti in all its essential features. The majority of the species of the genus *Ophiceras* in Painkhanda are also represented in the Ophiceras layer of Pastannah, among them all the leading forms. Among seven species of that genus hitherto known from Kashmir not a single one is new.

In the Otoceras fauna of the Shalshal cliff the genus *Ophiceras* decidedly predominates among the Cephalopoda, both in the number of species and of individuals. In Kashmir the genus *Xenodiscus* Waag. plays an equally important part. The establishment of the intimate relationship of those two genera has been one of the most interesting results of my examination of the materials collected from the Ophiceras layer of Pastannah by C. S. Middlemiss. I have been able to discover a considerable number of specimens, which must be considered as transitional forms between *Ophiceras* and *Xenodiscus*.

Together with four species of *Xenodiscus* (*X. Himalayanus, Lissarensis, ellipticus, Sitala*), which have been described previously from the Lower Trias of the Central Hamalayas, there occur at least four new species, some of them of considerable interest for their probable affinity with *Kashmirites* and *Sibirites*. Two species are closely allied to or, perhaps, even identical with *X. rotula* Waag. and *X. ophioneus* Waag. from the Ceratite formation of the Salt Range.

Vishnuites Pralambha must be added to the species which are common to the Ophiceras layer of Pastannah and to the Otoceras beds of Painkhanda. *Pseudosageceras clavisellatum* is an independent species of this remarkable genus. It differs from the Indo-Pacific forms hitherto known by the club-shaped outlines of the majority of larger saddles in the sutural line.

The genus *Otoceras* Griesb. has not been discovered in the Ophiceras fauna of Pastannah. It is either really absent in the Lower Trias of Kashmir—it is already extremely rare in Spiti—or it is restricted to the deepest zone of the Ophiceras layer, as in Spiti, which has not been found yet in the outcrops near Pastannah. C. S. Middlemiss in his report (*l.c.*, p. 242) especially remarks that the outcrops of the Lower Trias along the little spurs W. by S. of Pastannah are partly hidden by the prevailing forest and soil-covered dip-slopes and that they

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consist chiefly of blocks *in situ* and only occasionally of definite layers of limestone, at least 300 feet in thickness, of which some 50 feet are specially fossiliferous.

The results obtained from the study of the Cephalopoda in the Ophiceras layer of Pastannah are of little stratigraphical interest. An important contribution to our knowledge, however, has been added by an examination of the numerous Lamellibranchiata, all of them belonging to the genus *Pseudomonotis*. They are found in large numbers, associated with the Ammonites on the same slabs of rock. There can be, consequently, no doubt as to their stratigraphical position in the Lower Trias of Kashmir. Although well preserved examples are comparatively rare, a safe identification of at least six species could be ascertained. The most common species are two forms of *Claraia*, described by A. Bittner, *P. Griesbachi* and *P. Painkhandana*, but together with them four species have been noticed, which deserve our special attention, because they represent some isolated elements of Mediterranean origin within the faunistic region of the Indian Triassic province.

The group of *Claraia* is represented by a single Mediterranean element, *Cl. aurita* Hau. The rest of such elements are radially ribbed shapes belonging to the group of *Eumorphotis* Bittn. One of them agrees exactly with *E. tenuistriata* Bittn., from the red Werfen sandstone of Ravnau, Bokhara, which in its development shows a remarkable similarity to the Alpine facies of the Werfen beds, but differs entirely from the Indian Lower Trias. This species, which is easily distinguished from the congeneric forms, by its delicate and uniform sculpture, is accompanied by a second species, which, according to the variability of its ornamentation, must be united with *E. multiformis* Bittn. *E. multiformis* has its habitat both in the Lower Triassic Proptychites beds of Vladivostok and in the red Myophoria sandstone of Ravnau. We are, consequently, allowed to place it among the Mediterranean elements of the Lower Trias of Kashmir. The third species is very closely allied to the Alpine *P. austriaca* Bittn., from which it differs only by some insignificant details in the shape of the anterior wing.

This is an assemblage of Mediterranean faunistic elements, which are nearly all leading forms of the Werfen beds in the Alpine region. *P. aurita* especially is restricted to the lower division of the Werfen beds, the horizon of Seis, and does not reach into the younger horizon of Campil. This result is not without some importance in the correlation of the Otoceras beds of the Himalayas with the Triassic system. This correlation, as is well known, has been a matter of discussion between different authors. The Otoceras beds, which were considered as passage beds by Griesbach and included in the Lower Trias by E. v. Mojsisovics, Bittner and myself, have been placed in the Permian system by Noetling, Frech and A. v. Krafft, although this last named author hinted at the possibility that a correlation of the Ophiceras layer in Spiti with the Lower Trias might be more correct.

Among the reasons in favour of a Triassic age of the Otoceras beds I have always insisted, in accordance with Bittner, on the close affinity of the Lamelli-

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branchiata from the Otoceras stage with the bivalve fauna of the Alpine Werfen beds. This argument has been strongly corroborated by the discovery of four true Werfen species in the Ophiceras layer of Pastannah. They impart to the bivalve fauna of this horizon a decidedly Triassic habit. Any attempt to draw the boundary between the Permian and Triassic systems above the Otoceras stage is in strict opposition to this Triassic habit of the Lamellibranchiata of that stage. The bivalve fauna of the Ophiceras layer of Kashmir proves its decidedly Triassic habit not by the presence of a single leading form, but by an assemblage of species, which in this association are characteristic of the Mediterranean Lower Trias and have as yet never been found in Palæozoic strata. Among all the Lamellibranchiata from the Ophiceras layer of Pastannah *Pseudomonotis Painkhandana* Bittn. is the only Indian faunistic element, which is altogether unknown in the Alpine Trias.

It might, perhaps, be proposed to retain the thin bed in the Permian system, to which the genus *Otoceras* is restricted in Spiti, and to draw the boundary between the two systems above this bed but below the following one, which contains the main layer of *Ophiceras*. Such an attempt to divide the Otoceras stage in two groups, separated by a line which would mark the boundary between the Palæozoic and Mesozoic systems, could scarcely be recommended, because in the classical section of the Shalshal cliff the characteristic species of *Ophiceras* are associated with *Otoceras* in the same bed, and *Otoceras* itself—according to Frech and Noetling—is met with in still higher beds above the top of its main layer.

A younger fauna of Lower Triassic age is contained in a dark-grey, coarse, semi-crystalline limestone, which is occasionally rich in fragments of crinoid stems. It forms the hor. **1** to **4**, 6-8-08, in the Guryul ravine, Khunmu. The fauna consists of the following species :—

Flemingites sp. ind. (group of *F. Flemingianus* Kon.).
,, *sp. ind.* (*cf. Muthensis* Krafft).
Meekoceras sp. ind. aff. Jolinkense Kr. et Dien.
,, (*Koninckites*) *cf. Yudishthira* Dien.
,, (*Aspidites*) group of *A. Kingianus* Waag.
Pseudosageceras sp. ind.
Prionites Guryulensis nov. sp.
Sibirites Kashmiricus nov. sp.
Kashmirites nov. gen. Blaschkei nov. sp.
,, *subarmatus nov. sp.*
,, *sp. ind. aff. subarmato.*
,, *sp. ind. aff. lævigato* Waag.
Stephanites sp. ind. aff. superbo Waag.
Nannites sp. ind.
Pseudomonotis (*Claraia*) *decidens* Bittn.

A faunula from Mandakpal, hor. **4**, 14-8-08, containing the following three species :—

Sibirites sp. ind. aff. ibex Waag.
Kashmirites sp. ind.
Pseudomonotis (*Claraia*) *decidens* Bittn.

evidently corresponds in age to the fauna from the Guryul ravine.

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In spite of the great dearth of materials it is easy to see at a glance that we have to deal here with a fauna of the Hedenstrœmia stage of Spiti and Painkhanda. The correctness of this correlation is evident from the presence of *Flemingites*, *Koninckites cf. Yudishthira*, *Sibirites*, *Pseudomonotis decidens*. A type not known from the Central Himalayas is *Kashmirites*, which reveals the close relationship of the Lower Trias of Kashmir with the Ceratite formation of the Salt Range. Such relations are also indicated by the presence of a species of *Prionites* and of *Stephanites aff. superbo* in the fauna of the Guryul ravine, of *Sibirites sp. aff. ibex* in the fauna of Mandakpal. The group of *Celtites armatus* Waag. (*Kashmirites*) has its chief habitat in the upper division of the Ceratite sandstone, the genera *Stephanites* and *Sibirites* are restricted to the upper Ceratite limestone, whereas *Prionites* has been found both in the Ceratite sandstone and upper Ceratite limestone. The presence of those genera in the abovementioned faunæ of Kashmir is, therefore, fully in accordance with a correlation of the Hedenstrœmia beds with the higher divisions of the Ceratite formation.

The faunal guides are not sufficient to decide the question whether or no two different palæontological zones are indicated in the collections from the Lower Trias of the Guryul ravine, an older one with *Flemingites sp.* and *Koninckites cf. Yudishthira* (zone of *Hedenstrœmia Mojsisoricsi*), and a younger one with *Sibirites sp.* and *Stephanites sp.*, which might correspond in age to the horizon of *Sibirites spiniger* Krafft et Dien. in Byans.

The horizon in the section of the Guryul ravine was the first fossiliferous horizon of undoubtedly Triassic age, which was discovered by C. S. Middlemiss in 1908. It then seemed probable to him (Gondwanas and related marine sedimentary systems of Kashmir, *Records, Geol. Surv. of India*, XXXVII, p. 303) that the beds **1** to **4**, 6-8-08, "represent the Meekoceras horizon of Spiti and the Kumaon and Garhwal Himalayas, and therefore that the two lowest Trias horizons, namely, those of *Otoceras* and *Ophiceras*, are missing in the section or else have not been detected."

Mr. Middlemiss was quite correct in excluding any correlation of the beds **1** to **4**, 6-8-08, with the Otoceras beds, but from my examination of their fauna they must be placed still higher in the sequence than the Meekoceras beds of India, and be considered as equivalents of the Hedenstrœmia stage. One single fossil, *Meekoceras sp. ind. aff. Jolinkense* Krafft et Dien. points, perhaps, to the horizon of *M. Lilangense* Kr. in Spiti. But a direct identity of the specimens from the Guryul ravine with the types from Lilang has not been established. All the rest of species are characteristic of the upper division of the Lower Trias.

As regards the stratigraphical horizons of the Lower Trias in Kashmir identified from my examination of the fossils obtained by Mr. C. S. Middlemiss, two characteristic fossil zones, the *Ophiceras* and *Hedenstrœmia* stage of Spiti, have been ascertained. A third zone is, perhaps, indicated by the faunula of the hor. ×, 4-9-09, from loose blocks in the detrital fans near Pastannah. The only species determinable is *Hungarites Middlemissii nov. sp.* The habitat of a second species, *Inyoites kashmiricus nov. sp.*, which is barely distinguishable from

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the American *I. Owenii* Hyatt et Smith, is rather doubtful. All the rest of the Ammonites mentioned by C. S. Middlemiss (*l.c.*, p. 243) are indeterminable.

There are still several omissions in the zonal sequence of the Lower Trias in Kashmir. In particular the fauna of the Meekoceras stage has not yet been demonstrated to occur in any of the sections examined. But nevertheless the progress made by the careful researches of Mr. C. S. Middlemiss is very considerable, the long supposed absence of the Lower Trias in Kashmir having been definitely proved by him to be a misconception. The unusual thickness of the Lower Trias in the Vihi sections leaves a sufficient mass of unsearched limestones still remaining, to inspire us with the hope that further researches may complete the zonal sequence.

The relation, which the Himalayan Lower Trias bears to the homotaxial beds in the Mediterranean, Arctic and Pacific regions, has been fully discussed in the final chapter of my memoir on the Lower Triassic Cephalopoda of Spiti (Himalayan Foss., *l.c.*, Vol. VI, Pt. 1). But the true affinities of the Indian and Alpine faunæ have been since brought to light by the discovery of the beautiful fauna of Kcira in Albania by F. v. Nopcsa. Here a facies of red limestones, agreeing with those of Han Bulog and Hallstatt, has been found for the first time in the Mediterranean Lower Trias, containing a rich fauna of Cephalopoda (62 species), which stands in striking contrast with the poor Werfen fauna with its distinct local character. In this fauna, which has been recently described by G. v. Arthaber (Die Entdeckung der Untertrias in Albanien und ihre faunistische Bewertung, *Mitteil. Geol. Gesellsch. Wien*, I, 1908, p. 245, Die Trias von Albanien, *Beitræge zur Geol. u. Palæontol. Oesterreich-Ungarns*, etc., XXIV, Heft 4), many elements make their appearance, which had been hitherto considered as peculiar to the Himalayan and American Triassic regions.

The fauna of Kcira is homotaxial with the Hedenstrœmia stage of India. The following genera and sub-genera, previously unknown in the Mediterranean Lower Trias, are common to both faunæ :—*Pseudosageceras* Dien., *Hedenstrœmia* Waag., *Proptychites* Waag., *Xenodiscus* Waag., *Xenaspis* Waag., *Ophiceras* Griesb., *Aspidites* Waag., *Prosphingites* Mojs., *Sibirites* Mojs. The number of identical or nearly identical forms is comparatively small; the following eleven species have been enumerated by G. v. Arthaber :—

Nannites Herberti Dien.
Proptychites obliqueplicatus Waag.
Japonites Sugriva Dien.
Monophyllities Pitamaha Dien.
,, *Kingi* Dien.
,, *Hara* Dien.
Meekoceras radiosum Waag.
Ophiceras Sakuntala Dien.
,, *cf. Nangaensis* Waag.
Anasibirites cf. dichotomus Waag.
Styrites Lilangensis Dien.

The identity of some of these species with their Indian prototypes is questionable. The type-specimen of *Proptychites obliqueplicatus* Waag. from Kufri

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has been so badly preserved, that it is nearly impossible to safely identify it with the Albanian species, which differs from it in the shape of its transverse section. The Albanian species of *Japonites* must certainly be kept separate from *J. Sugriva* Dien., on account of some remarkable differences in the sutural line. The specimen identified with *Ophiceras Sakuntala* by G. v. Arthaber does certainly not represent the typical form of that species, but may fall within the range of its variations, if the species is taken in a wider circumscription. *Ophiceras cf. Nangaensis* and *Anasibirites cf. dichotomus* from Albania are sufficiently distinguished from the Indian species to have the *cf.* replaced by *aff.*

On the other hand there is a very large majority of faunistic elements in the Lower Trias of Keira, which impart to it a peculiar provincial character. The Albanian representatives of *Proptychites* are distinguished from the Indian ones by the club-shaped saddles of their sutural lines. *Pronorites* Mojs., *Beatites* Arth., *Procarnites* Arth., *Dagnoceras* Arth., *Protropites* Arth., *Prenkites* Arth., *Arianites* Arth., *Paragoceras* Arth., *Epiceltites* Arth. are peculiar to the fauna of Keira. The distinct provincial character of this fauna, which distinguishes it from the homotaxial faunæ of the Indian and Pacific regions, is evident. Nevertheless there can be no more doubt of the former existence of an open connexion of the sea between the Himalayan and Mediterranean regions.

Noetling's conclusion, that during the Lower Triassic period the Tethys was interrupted by a barrier somewhere between Bokhara and the Indus, has been proved to be untenable by the discovery of *Tirolites* in the Hedenstrœmia beds of Muth, by the invasion of Mediterranean types of *Pseudomonotis* in the Ophiceras layer of Pastannah, and last but not least by the results of G. v. Arthaber's examination of the fauna of Keira. But although an open communication between the Himalayan and Mediterranean sea-basins through the Tethys was not prevented by a barrier, as has been suggested by Noetling, a complete exchange of Indian and Alpine Cephalopoda was effected as little as in Upper Triassic times. The contrast between the two faunæ is, therefore, still sufficiently strong to designate the two regions of their local development as distinct zoogeographical provinces. The majority of species, which were able to immigrate from one region into the other, took an independent line of development.

There are no affinities with the Lower Triassic faunæ of the Arctic region. The only Himalayan species, which might be compared to a form of the Olenek fauna, is *Xenodiscus cf. ophioneus* Waag., which exhibits a close similarity to *X. multiplicatus* Mojs.

II.—MUSCHELKALK.

According to the description of Mr. C. S. Middlemiss, the Muschelkalk of Kashmir consists of a mass of shales and limestones, about 900 feet in thickness, which gradually passes into the Upper Trias.

The lowermost beds in all the sections are sandy limestones, interbedded with shales, and unfossiliferous. Neither the bivalve-limestone with *Pseudomonotis*

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himaica Bittner, nor the horizon of *Rhynchonella Griesbachi* Bittn., two very characteristic horizons at the base of the Muschelkalk in Spiti, have as yet been discovered. Nor do the sections in the Vihi district show any steep escarpment in the Lower Muschelkalk, which might be compared to the Niti limestone of Painkhanda and Spiti.

From A. v. Krafft's and Hayden's reports (Geology of Spiti, *Memoirs, Geological Surv. of India*, XXXVI, Pt. 1, p. 69) the almost perfect identity in the development of the Muschelkalk sections in Spiti, Painkhanda and Johar has become evident. In all those sections the following subdivisions of the Muschelkalk can be distinguished in descending order :—

5. Upper Muschelkalk, very rich in Cephalopoda.
4. Horizon of *Spiriferina Stracheyi* Salt.
3. Horizon of *Keyserlingites* (*Durgaites*) *Dieneri* Mojs.
2. Nodular limestone (Niti limest.), unfossiliferous.
1. Horizon of *Rhynchonella Griesbachi* Bittn.

The uniformity in this development goes so far that almost every single bed found in the one area could be recognised in the other. It does not, however, extend into Eastern Johar (Byans), as has been proved by A. v. Krafft, nor into Kashmir, as is evident from the numerous sections published by C. S. Middlemiss, and from the examination of his collections. The fauna of *Durgaites Dieneri* is entirely absent in all his materials. *Spiriferina Stracheyi* does not keep a distinct horizon at the base of the Cephalopod facies of the Upper Muschelkalk, but seems to occur in two sections only, and in one of them is included between two fossiliferous horizons, both of them containing rich faunæ of the zone of *Ceratites trinodosus*.

In the following table of the more important sections, which have been examined by C. S. Middlemiss, a list of the fossils is given, which have been obtained from each horizon. For a comparison of the respective horizons the reader is referred to the original report (*l.c.*, pp. 244—256). In accordance with the opinion of Mr. C. S. Middlemiss, I consider the hor. **1,** 27-8-08, in the section of Pastannah, and hor. **2,** 17-9-09, as a standard horizon (*A*) for further references.

I.—Section near Pastannah and one mile W. of Pastannah.

(in ascending order)

hor. **3,** 3-9-09 (5 feet below *A*) :—

Ceratites (*Hollandites*) *Ravana* Dien., which has its main layer in this horizon.
Beyrichites Khanikofi Opp.
,, *Kesava* Dien.
Sibirites cf. Prahlada Dien.
Acrochordiceras cf. Balarama Dien
Gymnites Sankara Dien.
,, *nov. sp. ind.*
Mojsvaroceras sp. ind. aff. nivicola Dien.
Orthoceras cf. campanile Mojs.
Mysidioptera eximia Dien.

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A. hor. **1,** 27-8-09 (**1,** 8-9-09, one mile W. of Pastannah), 500 feet above the top of the Lower Trias :—

Ceratites Thuilleri Opp.
,, *truncus* Opp.
,, (*Hollandites*) *Ravana* Dien.
,, (,,) *Voiti* Opp.
,, (,,) *Dungara* Dien.
,, (,,) *cf. Arjuna* Dien.
,, (,,) *Vyasa* Dien.
,, (,,) *sp. ind. aff. Cecilii* Dien.
,, (*Halilucites*) *sp ind.*
Beyrichites Khanikofi Opp.
Hungarites sp. ind.
Isculites sp. ind. (I).
,, ,, ,, (II).
Smithoceras sp. ind.
Gymnites Jollyanus Opp.
,, *Vasantasena* Dien.
,, *cf. Kirata* Dien.
,, *Sankara* Dien.
Buddhaites Rama Dien.
Mojsvaroceras Kagæ Dien.
Thuringionautilus sp. ind.
Grypoceras Vihianum nov. sp.
Orthoceras cf. campanile Mojs.
Worthenia Dharmaensis Blaschke.
Promathildia sp. ind.
Euomphalus sp. ind.
Marmolatella sp. ind.
Scurria sp. ind.
Modiola sp. ind.
Perna sp. ind. aff. vetustæ Goldf.
Avicula Pastannahensis nov. sp.
Lima sp. ind. (*striatæ*).
,, *sp. ind. aff. subpunctata* d'Orb.
Mysidioptera eximia nov. sp.
,, *sp. ind.*
Lithophagus sp. ind.
Spiriferina (*Mentzelia*) *cf. Koeveskalliensis* Suess.

hor. **2,** 27-8-09, 20 feet above *A* :—

Ceratites Thuilleri Opp.
,, (*Hollandites*) *Ravana* Dien.
Acrochordiceras cf. Balarama Dien.
Gymnites Jollyanus Opp.
Buddhaites Rama Dien.

hor. **1—2,** 30-8-09, 200 feet above *A* :—

Ceratites sp. ind.
Myophoria sp. ind. aff. lævigatæ Ziet.

hor. **1,** 12-9-09, 250—300 feet above *A* :—

Rhynchonella Lamana nov. sp.

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II.—Section near Khrew in the Vihi Plain.

(in ascending order)

A. hor. **2,** 17-9-09, Lower Gymnites layer, corresponding to hor. **1,** 27-8-09, of the Pastannah section, according to C. S. Middlemiss, 350 feet above base :—

Ceratites Thuilleri Opp.
,, *onustus* Opp.
Beyrichites Khanikofi Opp.
Smithoceras Herminæ Dien.
Gymnites Jollyanus Opp.
,, *Sankara* Dien.
Buddhaites Rama Dien.
Mojsvaroceras Kagæ Dien.
Syringonautilus sp. ind. aff. Carolinæ Mojs.
Paranautilus Kashmiricus nov. sp.
Orthoceras cf. campanile Mojs.
Worthenia Dharmaensis Bl.

hor. **1,** 17-9-09, Upper Gymnites layer, 5 feet above *A* :—

Ceratites Thuilleri Opp.
Gymnites sp. ind.
Mojsvaroceras Kagæ Dien.

hor. **4,** 15-9-09, 350 feet above *A* :—

Ceratites sp. ind. aff. falcifer Hau.
Spiriferina Stracheyi Salt.
Rhynchonella trinodosi Bittn.

hor. **3,** 15-9-09, following immediately above hor. **4,** 15-9-09 :—

Ceratites sp. ind. aff. superbo Mojs.
Acrochordiceras cf. enode Hau.
Gymnites sp. ind.

hor. **2½,** 15-9-09, 475 feet above *A* :—

Ceratites sp. ind.

hor. **2,** 16-9-09, 530 feet above *A* :—

Ceratites cf. trinodosus Mojs.
Proteites indicus nov. sp.
Buddhaites Rama Dien.
Ptychites sp. ind.
Mojsvaroceras Kagæ Dien.
Grypoceras Vihianum nov. sp.
Myophoria sp. ind. aff. lævigatæ Ziet.
,, ,, ,, (*carinatæ*).
Lima sp ind. aff. subpunctatæ d'Orb.
Pecten sp. ind.
Anomia triadica nov. sp.
Anodontophora sp. ind.

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III.—Spur N.N.E. of Khunmu.

hor. **7,** 11-8-08, corresponding probably to hor. **2.** 16-9-09, of the Khrew sections :—

Ceratites Thuilleri Opp.
Isculites Middlemissii nov. sp.
Ptychites Sahadeva Dien.
„ *Barclayi nov. sp.*
„ *Cunninghami nov. sp.*
Pecten sp. ind.

IV.—Section E. of Guryul Ravine.

(in descending order)

hor. **7,** 11-8-08, corresponding to the same horizon in the section N.N.E. of Khunmu :—

Ceratites Thuilleri Opp.
„ *Kuvera* Dien.
„ *sp. ind. aff. superbo* Mojs.
Pinacoceras cf. Loomisii Dien.
Buddhaites Rama Dien.
Mojsvaroceras Kagæ Dien.
Orthoceras cf. campanile Mojs.
Conularia sp. ind.
Myophoria sp. ind. aff. lævigatæ Ziet.
Pleurophorus sp. ind. aff. Curionii Hau.
Lima sp. ind. aff. subpunctatæ d'Orb.

hor. **6,** 11-8-08 :—

Arcoptera indica nov. sp.
Spiriferina Stracheyi Salt.
Dielasma Himalayanum Bittn.
Rhynchonella trinodosi Bittn.

V.—Sections in the neighbourhood of Lam, Patarkul Valley.

(in ascending order)

hor. **3,** 16-8-09, 300 feet above the top of the Lower Trias :—

Acrochordiceras cf. Haueri Arth.
Buddhaites Rama Dien.
Lima sp. ind. aff. subpunctatæ d'Orb.
Anodontophora Patarkulensis nov. sp.

hor. **3½,** 16-8-09 :—

Ptychites Brueckneri nov. sp.

hor. **3¾,** 16-8-09 :—

Ceratites sp. ind. aff. binodoso Mojs.
Mojsvaroceras Kagæ Dien.
Orthoceras cf. campanile Mojs.
Anomia triadica nov. sp.

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hor. **3 $\frac{1}{5}$**, 16-8-09 :—

Ceratites Thuilleri Opp.
„ *sp. ind. aff. Thuilleri* Opp.
Ptychites sp. ind.

hor. **4**, 16-8-09 :—

Rhynchonella mutabilis Stol.
„ *Lamana nov. sp.*

If we compare the fossiliferous horizons, which have so far been discovered in the Muschelkalk of Kashmir by C. S. Middlemiss, as shown in the preceding table, we see at once that they contain a single fauna, consisting of the well-known types of the *trinodosus* zone of the Central Himalayas. There is only one single species, *Sibirites cf. Prahlada* Dien., among the forms enumerated, which might, perhaps, indicate an element of the fauna of the Lower Muschelkalk with *Durgaites Dieneri* Mojs. Nor can the brachiopod horizon of the section of Khrew (hor. **4**, 15-9-09) with *Spiriferina Stracheyi* Salt. be considered as belonging to the top of the lower subdivision of the Muschelkalk, as it might be anticipated from A. v. Krafft's researches in Spiti. In Spiti this brachiopod horizon is directly underlain by the horizon with the fauna of *Durgaites Dieneri*, in the section of Khrew it is included between two fossiliferous horizons, both of them containing a typical fauna of the *trinodosus* zone of the Upper Muschelkalk.

In face of such convincing evidence we must look for the equivalents of the Lower Muschelkalk, as developed in Spiti and Painkhanda, in the mass of thin-bedded shales and shaly limestones below the standard horizon *A* of the Pastannah and Khrew sections, which hitherto have not yielded any determinable fossils. Their considerable thickness—300 to 500 feet—makes it probable that sections worth searching for fossils will be found later on.

I consequently fully agree with the correlation of the fossiliferous beds of the Muschelkalk, as proposed by C. S. Middlemiss in his report (*l.c.*, p. 247). In the sections of Kashmir—he states—"there is no trace of a Lower Muschelkalk fauna, as particularly exemplified by the genus *Monophyllites*, the characteristic group of *Ceratites subrobusti*, and the brachiopod layer with *Rhynchonella Griesbachi*."

The horizons distinguished by C. S. Middlemiss in the Upper Muschelkalk of Kashmir are only of local importance. A fact of particular interest is the restriction of *Gymnites* to the lower and of *Ptychites* to the higher beds, whereas the leading species of *Ceratites*, especially *C. Thuilleri* Opp., are indiscriminately distributed throughout the entire mass of the Upper Muschelkalk. The beds containing brachiopods do not form a constant and widespread horizon. It is, to say the least, impossible to establish a direct correlation between hor. **4**, 15-9-09, of Khrew, and hor. **6**, 11-8-08, of the Guryul ravine on one side and hor. **1**, 12-9-09, of Pastannah, and hor. **4**, 16-8-09, of Lam on the other.

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The following species are represented in the fauna of the Upper Muschelkalk of Kashmir :—

Ammonoidea.

1. *Ceratites Thuilleri* Opp.
2. „ *cf. trinodosus* Mojs.
3. „ *sp. ind. aff. Thuilleri* Opp.
4. „ *Kuvera* Dien.
5. „ *sp. ind. aff. binodoso* Hau.
6. „ *truncus* Opp.
7. „ *onustus* Opp.
8. „ *sp. ind. aff. superbo* Mojs.
9. „ *sp. ind. aff. falcifer* Hau.
10. „ (*Hollandites*) *Voiti* Opp.
11. „ („) *Ravana* Dien.
12. „ („) *Dungara* Dien.
13. „ („) *cf. Arjuna* Dien.
14. „ („) *Vyasa* Dien.
15. „ („) *sp. ind. aff. Cecilii* Dien.
16. „ (*Halilucites*) *sp. ind.*
17. *Beyrichites Khanikofi* Opp.
18. „ *Kesava* Dien.
19. *Hungarites sp. ind.*
20. *Sibirites cf. Prahlada* Dien.
21. *Proteites indicus nov. sp.*
22. *Acrochordiceras cf. enode* Hau.
23. „ *cf. Haueri* Arth.
24. „ *cf. Balarama* Dien.
25. *Isculites Middlemissii nov. sp.*
26. „ *sp. ind.* (I).
27. „ *sp. ind.* (II).
28. *Smithoceras Herminæ* Dien.
29. „ *sp. ind.*
30. *Pinacoceras cf. Loomisii* Dien.
31. *Ptychites Sahadeva* Dien.
32. „ *Brueckneri nov. sp.*
33. „ *Cunninghami nov. sp.*
34. „ *Barclayi nov. sp.*
35. *Gymnites Jollyanus* Opp.
36. „ *Sankara* Dien.
37. „ *Vasantasena* Dien.
38. „ *cf. Kirata* Dien.
39. „ *nov. sp. ind.*
40. *Buddhaites Rama* Dien.

Nautiloidea.

41. (1) *Mojsvaroceras Kagæ* Dien.
42. (2) „ *sp. ind. aff. nivicola* Dien.
43. (3) *Thuringionautilus sp. ind.*
44. (4) *Syringonautilus sp. ind. aff. Carolinæ* Mojs.
45. (5) *Grypoceras Vihianum nov. sp.*
46. (6) *Paranautilus Kashmiricus nov. sp.*
47. (7) *Orthoceras cf. campanile* Mojs.

Conularida.

48. (1) *Conularia sp. ind.*

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GASTEROPODA.

49. (1) *Worthenia Dharmaensis* Bl.
50. (2) *Promathildia sp. ind.*
51. (3) *Euomphalus sp. ind.*
52. (4) *Marmolatella sp. ind.*
53. (5) *Scurria sp. ind.*

LAMELLIBRANCHIATA.

54. (1) *Myophoria sp. ind. aff. lævigatæ* Ziet.
55. (2) ,, *sp. ind. (carinatæ).*
56. (3) *Pleurophorus sp. ind. aff. Curionii* Hau.
57. (4) *Modiola sp. ind.*
58. (5) *Arcoptera indica nov. sp.*
59. (6) *Perna sp. ind. aff. vetustæ* Goldf.
60. (7) *Avicula Pastannahensis nov. sp.*
61. (8) *Lima sp. ind. (striatæ).*
62. (9) ,, *sp. ind. aff. subpunctatæ* d'Orb.
63. (10) *Mysidioptera eximia nov. sp.*
64. (11) ,, *nov. sp. ind.*
65. (12) *Pecten sp. ind.*
66. (13) *Anomia triadica nov. sp.*
67. (14) *Anodontophora Patarkulensis nov. sp.*
68. (15) ,, *sp. ind.*
69. (16) *Lithophagus sp. ind.*

BRACHIOPODA.

70. (1) *Spiriferina Stracheyi* Salt.
71. (2) ,, *(Mentzelia) cf. Koeveskalliensis* Suess.
72. (3) *Dielasma Himalayanum* Bittn.
73. (4) *Rhynchonella trinodosi* Bittn.
74. (5) ,, *mutabilis* Stol.
75. (6) ,, *Lamana nov. sp.*

Notwithstanding this long list the number of additions to the Cephalopoda of the Central Himalayas, the chief element of the Muschelkalk fauna, is rather small. Leaving out such species as have been considered unworthy of a specific denomination, they include altogether two forms of *Ammonoidea* and two forms of *Nautiloidea*, namely :—

Proteites indicus.
Isculites Middlemissii.
Grypoceras Vihianum.
Paranautilus Kashmiricus.

The faunistic differences between the Spiti and Niti areas on one hand and the Muschelkalk sections of Kashmir on the other are not very important. The most remarkable, perhaps, is the numerical preponderance of *Gymnites* and *Buddhaites* and the comparative scarcity of *Ptychites*. Whereas in Spiti and Painkhanda the latter genus is remarkably rich in forms and distributed throughout the entire mass of the Upper Muschelkalk, although attaining its maximum development in the topmost beds, it is entirely restricted to the latter in Kashmir

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and represented by the group of *megalodisci* only. The *rugiferi*, which in the number of species and individuals play the most important part in the Muschelkalk of Painkhanda, are completely absent.

Ammonea trachyostraca and *leiostraca* are found in almost equal number. The *Ceratites nodosi* are not considerably surpassed in number by the *circumplicati* (sub-genus *Hollandites*). As a leading fossil of the Muschelkalk of Kashmir *Ceratites Thuilleri* Opp. is nearly equal in importance to *Gymnites Jollyanus* Opp. or *Buddhaites Rama* Dien. Among the *nodosi* three new species—

Ceratites nov. sp. aff. superbo Mojs.
" " " " *binodoso* Hau.
" " " " *falcifero* Hau.

are closely allied to Alpine forms. The *Tropitoidea* are represented by two genera, *Smithoceras* Dien. and *Isculites* Mojs. *Isculites Middlemissii* is the largest type of that genus hitherto known. *Smithoceras Herminæ* is identical with a species from the Muschelkalk of the Shalshal cliff. No representative of the *Arcestoidea* has as yet been found in the Muschelkalk of Kashmir. We must look for them in the facies of red Hallstatt limestones, which have as yet not been discovered beyond the area of exotic blocks in the neighbourhood of Chitichun and Sangcha Talla.

Among the *Nautiloidea Grypoceras Vihianum* is worthy of mention on account of its relationship to Alpine *Grypoceratidæ* (*G. Suessii*, *G. galeatum*) of Upper Triassic age.

The normal Upper Muschelkalk in the Spiti and Niti areas is a cephalopod-bearing facies, in which Ammonites and Nautiloidea enormously predominate. In the Muschelkalk of Kashmir the class of Lamellibranchiata is also very richly represented. Some beds of limestone are full of small shells, which at a first glance might with equal reason be attributed to either *Pseudomonotis* or *Lima*, but actually most probably belong to the latter genus. The number of forms worthy of a specific name is, unfortunately, small. No adequate idea of the true importance of this class of Mollusca can consequently be got from the few descriptions in the present memoir. The oldest species of *Anomia* and the largest species of *Mysidioptera* occur here. In the higher beds of the Muschelkalk a species of *Myophoria* makes its appearance, which unites some features of the German *M. lævigata* Ziet. and of the Alpine *M. Keferstcinii* Muenst. Although close affinities with European forms are indicated in many cases, a direct specific identity of Alpine and Himalayan shells is not known to me.

III.—UPPER TRIAS.

In all the sections of Kashmir the Muschelkalk passes gradually into beds of Upper Triassic age. This gradual passage is evident from the descriptions given by C. S. Middlemiss. The beds of the Upper Trias are more massive than those of the Muschelkalk and " finally build an array of picturesque crags and

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precipices, towering high above the surrounding country." But no distinct boundary can be drawn between the two groups.

The development of the Upper Trias in Kashmir, which attains several thousands of feet in thickness, is quite different from that known in the Central Himalayas of the Spiti and Niti areas, "there being no Upper Trias Ammonites represented and also none of the very characteristic Daonella shales and Halobia limestones." (C. S. Middlemiss, *l.c.*, p. 246.)

It is only in the lower division of the Upper Trias that beds rich in Lamellibranchiata and Brachiopoda have been occasionally met with. The best sections, with Lamellibranch beds fairly well developed, are those in the neighbourhood of Pastannah, where fossils of the Carnic stage have been found from hor. **3,** 30-8-09, which is about 400 feet above *A*, the standard horizon of the Upper Muschelkalk, to hor. **6,** 30-8-09, about 200 feet above hor. **3,** 30-8-09. They are Lamellibranchiata, with the exception of one single species of Brachiopoda, *Dielasma julicum* Bittn.

The fauna of those four horizons contains the following species :—

Myophoria cf. Kefersteinii Muenst. *var. multiradiata* W.
,, *Middlemissii nov. sp.*
,, *sp. ind. aff. Whateleyæ* Buch.
Trigonodus sp. ind.
,, *nov. sp. ind.*
Hœrnesia Bhavani nov. sp.
Pseudomonotis sp. ind.
Lima cf. subpunctata d'Orb.
Mysidioptera sp. ind.
Pecten (Chlamys) Middlemissii nov. sp.
,, *(Velopecten) sp. ind.*
Dielasma julicum Bittn.

This fauna has a decidedly younger aspect than that of the Upper Muschelkalk. Although very scanty and meagre, it bears the stamp of a Carnic age. The genus *Myophoria* especially offers sufficient evidence for a correlation with Alpine faunæ.

The most remarkable type is a *Myophoria*, which undoubtedly belongs to the group of *M. Kefersteinii* Muenst. and can hardly be distinguished from the *var. multiradiata* Waag. of the Alpine shell. In the Mediterranean region *M. Kefersteinii* is one of the most characteristic elements of the Raibl beds (Julic substage). But the stratigraphical value of the Himalayan *Myophoria* is somewhat diminished by its very close affinity with a species from the Upper Muschelkalk, which in the present memoir has been compared with *M. lævigata* Ziet. The question arises, whether the Himalayan shell is, indeed, a straggler from the Mediterranean basin, which has entered the Indian Triassic province during the Julic period, or should rather be considered as a direct descendant from the Himalayan form of the Muschelkalk. In this case its similarity with *M. Kefersteinii* would be a case of convergency only, not of direct affinity. Provided our decision in favour of the latter alternative should be correct, the presence of this *Myophoria*

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could not be considered as a safe base for a correlation of the Upper Triassic horizons of Pastannah with the Julic sub-stage.

A second species of *Myophoria*, which is nearly allied to *M. Whateleyæ* Buch, one of the species of *Trigonodus*, *Lima cf. subpunctata*, *Dielasma julicum*, show all a Carnic habit. Their occurrence confirms what would be expected from the presence of *Myophoria cf. Kefersteinii*, *viz.*, that the Upper Triassic horizons of Pastannah approximately correspond in age to the Carnic stage (beds of St. Cassian and Raibl).

There are three more localities in Kashmir, from which fossiliferous beds of Upper Triassic age have been quoted by C. S. Middlemiss. The horizons and fossils are shown in the following list :—

I.—Spur N.N.W. of Khrew.

hor. **3**, **16-9-09**, **150** feet above the Ptychites bed, hor. **2**, **16-9-09**, and hor. **1—2**, 15-9-09 :—

Hœrnesia Bhavani nov. sp.
Spiriferina sp. ind. aff. lilangensis Stol.
,, *Stracheyi* Salt.
,, (*Mentzelia*) *cf. Mentzelii* Dunk.
Rynchonella trinodosi var. Freshfieldi Dien.

II.—Lam, Patarkul Valley.

hor. **1**, **16-8-09**, about **600** feet above hor. **3**, **16-8-09** :—

Gervilleia sp. ind.
Spiriferina Stracheyi Salt.

hor. **5**, **16-8-09**, **200** feet above the Ptychites bed, hor. **4**, **16-8-09** :—

Trigonodus sp. ind.
Pleurophorus cf. Curionii Hau.

III.—Narastan.

hor. **1**, 25-8-09, hor. **3**, 25-8-09 :—

Spiriferina Stracheyi Salt.
Rhynchonella Lamana nov. sp.

There is no evidence in favour of a correlation of these faunæ with the Carnic stage. On the contrary, the Brachiopoda point to the Muschelkalk, not to the Upper Trias, whereas the few Lamellibranchiata possess rather indifferent characters, not fit for an exact determination of the age. It must, however, be borne in mind that the Carnic fauna of the "Grey beds" in Spiti is also remarkable for the presence of several species of Brachiopoda, which are either identical with or allied very closely to Muschelkalk forms, among them *Mentzelia Mentzelii*

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and *Rhynchonella trinodosi var. Freshfieldi.* *Spiriferina Stracheyi* Salt. must now be added. It seems to range throughout the entire thickness of the Upper Muschelkalk into beds of Upper Triassic age, as is evident from its association with *Hœrnesia Bhavani*, one of the most characteristic species of the Upper Trias of Pastannah.

Notwithstanding the predominance of Muschelkalk types among the Brachiopoda, the beds including these meagre faunæ must be presumed to belong to the Upper Trias, as explained by C. S. Middlemiss in the description of his type-sections. Although the stratigraphical evidence is not supported by the palæontological results, it appears sufficient in this case to decide the question of age.

The presence of Upper Triassic beds of Noric or Rhætic age in Kashmir is evident from Lydekker's discovery of *Megalodon* in a dark limestone near Shargol, Ladakh (*Memoirs, Geol. Surv. of India*, XXII, p. 164). There is, however, no indication of this *Megalodon* limestone in the sections of the Vihi district, which have been studied by C. S. Middlemiss.

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PLATE I.

Fig. 1 *a*, *b*. Ophiceras Sakuntala Dien. forma typ.
„ 2 *a*, *b*. „ „ „ var.
„ 3. Ophiceras cf. gibbosum Griesb.
„ 4 *a*, *b*. Ophiceras cf. tibeticum Griesb.
„ 5 *a*, *b*. Ophiceras cf. medium Griesb.
„ 6. Ophiceras ptychodes Dien.
„ 7. Ophiceras Chamunda Dien.
„ 8. Ophiceras demissum Opp.
„ 9 *a*, *b*. Ophiceras demissum Opp.
„ 10. Ophiceras sp. ind. aff. gibboso Griesb.
„ 11. Xenodiscus cf. Lissarensis Dien.

All specimens from the Ophiceras layer of Pastannah, Lower Trias, hor. 1, 5-9-09.

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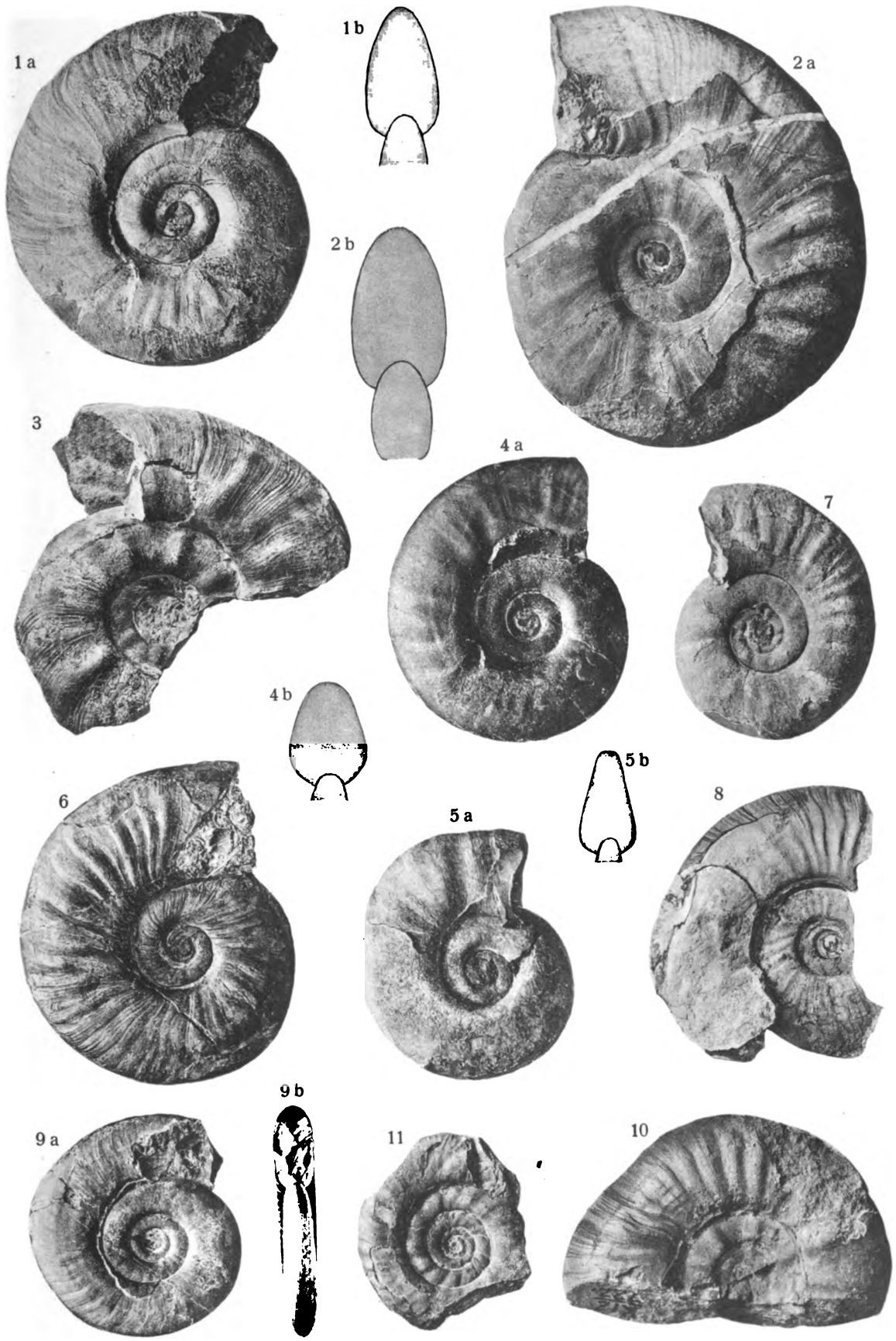

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PLATE II.

Fig. 1. Transitional form between Ophiceras Sakuntala Dien. and Xenodiscus Waagen.
„ 2 *a*, *b*. Transitional form between Ophiceras tibeticum Griesb. and Xenodiscus Waag.
„ 3 *a*, *b*. Xenodiscus himalayanus Griesb.
„ 4. Xenodiscus himalayanus Griesb.
„ 5 *a*, *b*. Xenodiscus Salomonii nov. sp.
„ 6 *a*, *b*. Xenodiscus Althothæ nov. sp.
„ 7*n* *a*, *b*. Xenodiscus Comptoni nov. sp.
„ 8 *a*, *b*. Xenodiscus cf. ophioneus Waag.
„ 9 *a*, *b*. Xenodiscus cf. ophioneus Waag.
„ 10 *a*, *b*. Xenodiscus æquicostatus nov. sp.
„ 11 *a*, *b*. Xenodiscus Althothæ nov. sp.

All specimens from the Ophiceras layer of Pastannah, Lower Trias, hor. 1, 5-9-09.

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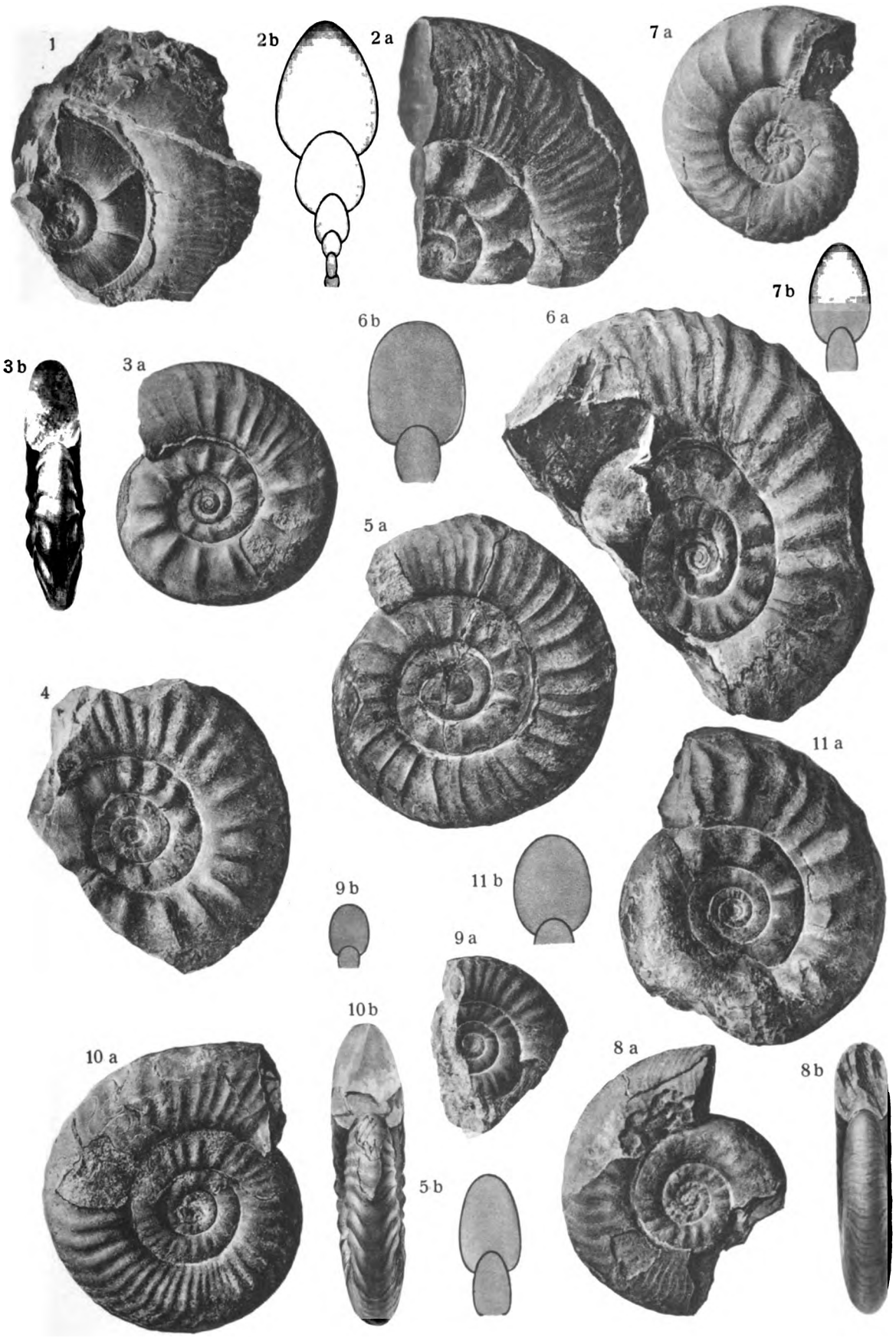

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PLATE III.

Fig. 1 *a*, *b*. Xenodiscus cf. ellipticus Dien.
„ 2 *a*, *b*. Xenodiscus cf. rotula Waag.
„ 3 *a*, *b*. Xenodiscus cf. Sitala Dien.
, 4 *a*, *b*. Vishnuites Pralambha Dien.

These four specimens from the Ophiceras layer of Pastannah, Lower Trias, hor. 1, 5-9-09.

„ 5 *a*, *b* *c*. } Hungarites Middlemissii nov. sp. { Lower Trias. Pastannah, hor. ×, 4-9-09.
„ 6.
„ 7 *a*, *b*.

„ 8 *a*, *b*, *c*. } Inyoites Kashmiricus nov. sp. { Lower Trias, exact horizon unknown. Pastannah.
„ 9.

„ 10 *a*, *b*. Nannites sp. ind.
„ 11 *a*, *b*, *c*. Kashmirites Blaschkei nov. sp.
„ 12 *a*, *b*, *c*. Kashmirites Blaschkei nov. sp.
„ 13 *a*, *b*. Kashmirites subarmatus nov. sp.

These four specimens from the upper division of the Lower Trias, E. of Guryul ravine, hor. 1, 6-8-08.

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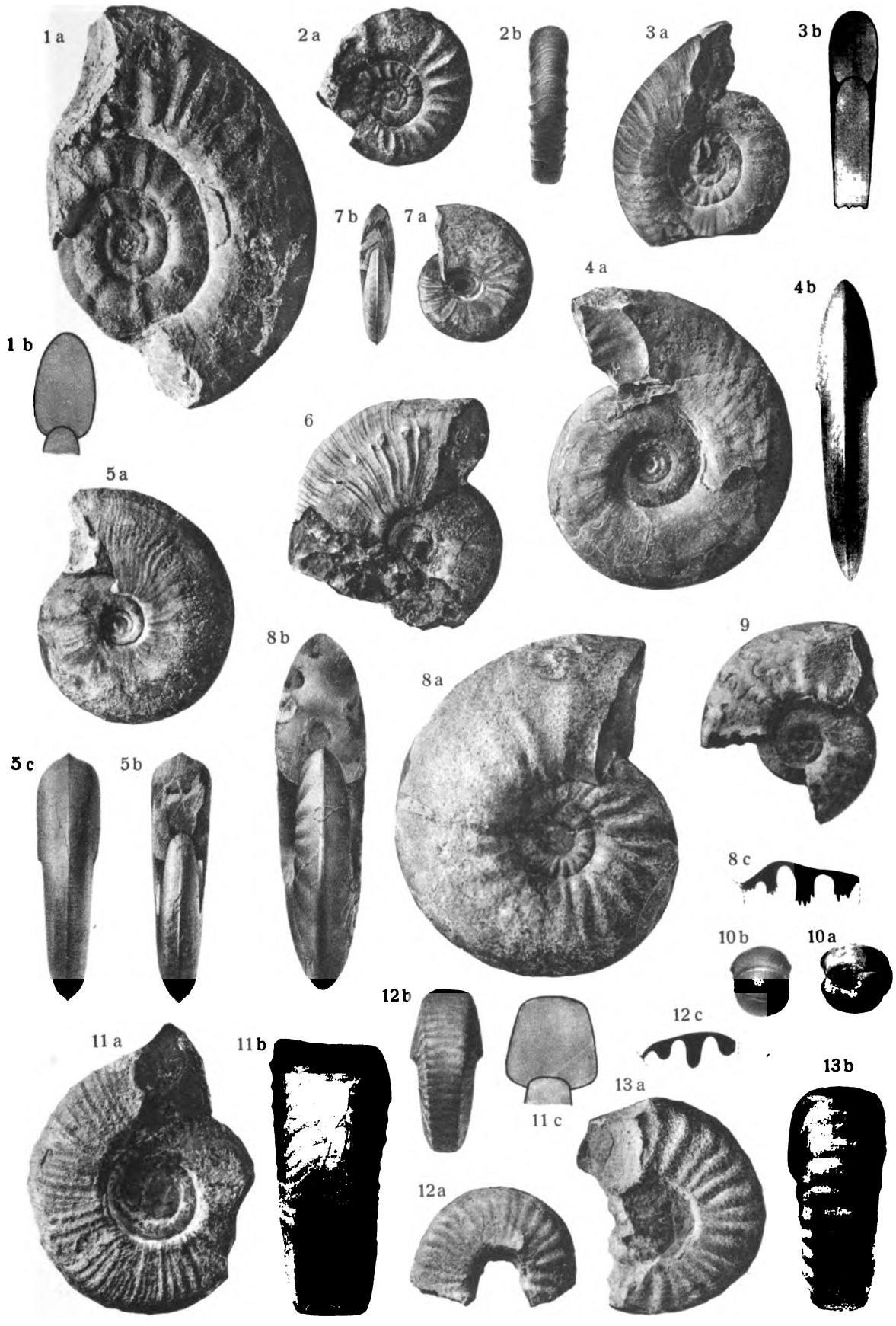

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PLATE IV.

Fig. 1 *a*, *b*, *c*. Prionites Guryulensis nov. sp.
„ 2 *a*, *b*, *c*. Koninckites cf. Yudishthira Dien.
„ 3 *a*, *b*. Meekoceras sp. ind. aff. Jolinkense Krafft.
„ 4 *a*, *b*. Flemingites (?) sp. ind. aff. Muthensis Krafft.

These four specimens from the upper division of the Lower Trias, E. of Guryul ravine, hor. **1**, 6-8-08.

„ 5 *a*, *b*, *c*. } Pseudosageceras clavisellatum nov. sp. Sutures twice enlarged.
„ 6 *a*, *b*. }

These two specimens from the Ophiceras layer of Pastannah, Lower Trias, hor. **1**, 5-9-09.

„ 7. Pseudosageceras sp. ind. Sutures.

Lower Trias, E. of Guryul ravine, hor. **1**, 6-8-08.

„ 8 *a*, *b*, *c*. Sibirites sp. ind. aff. ibex Waag.

Lower Trias, Mandakpal, hor. **4**, 4-8-08.

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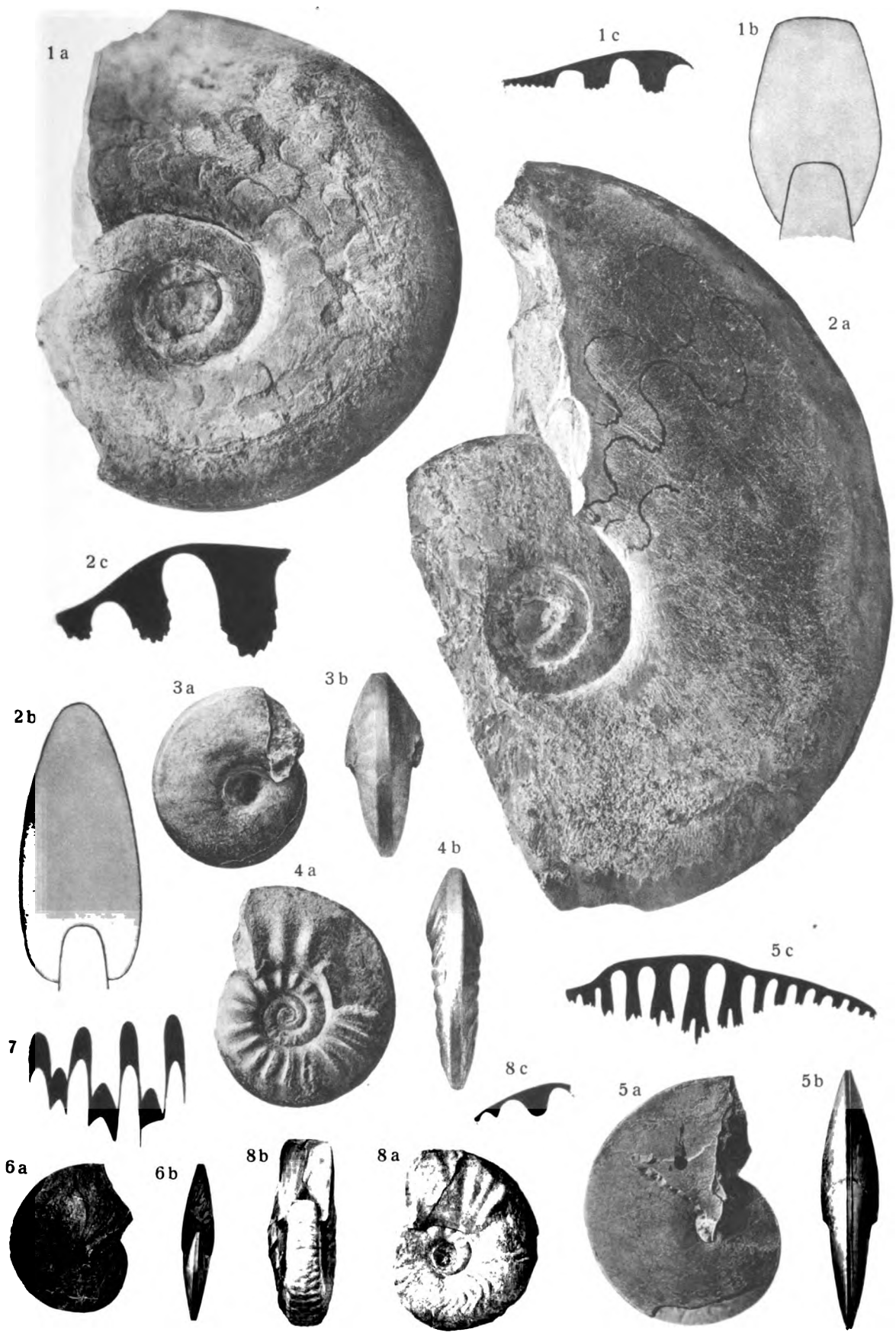

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PLATE V.

Fig. 1 *a, b, c.* Aspidites sp. ind. (group of A. Kingianus Waag.).
Lower Trias, E. of Guryul ravine, hor. **1**, 6-8-08.

„ 2 *a, b, c.* Kashmirites subarmatus nov. sp.

„ 3 *a, b.* Kashmirites subarmatus nov. sp.

„ 4 *a, b.* Stephanites sp. ind. aff. superbo Waag.

„ 5 *a, b.* Kashmirites sp. ind. aff. subarmato Dien.

„ 6 *a, b, c. d.* Kashmirites sp. ind. aff. lævigato Waag. Sutures twice enlarged.

„ 7 *a, b, c.* Sibirites kashmiricus nov. sp.

These six specimens from the upper division of the Lower Trias, E. of Guryul ravine, hor. **1**, 6-8-08.

„ 8 *a, b.* Pseudomonotis Griesbachi Bittn.

„ 9. Pseudomonotis aurita Hau.

„ 10 *a, b.* Pseudomonotis Painkhandana Bittn.

„ 11. Pseudomonotis tenuistriata Bittn.

„ 12. Pseudomonotis sp. ind. aff. austriaca Bittn.

„ 13. Pseudomonotis multiformis Bittn.

These six specimens from the Ophiceras layer of Pastannah, Lower Trias, hor. **1**, 5-9-09.

„ 14. *a, b, c.* Pseudomonotis decidens Bittn.

Upper division of the Lower Trias, E. of Guryul ravine, hor. **2**, 6-8-08.

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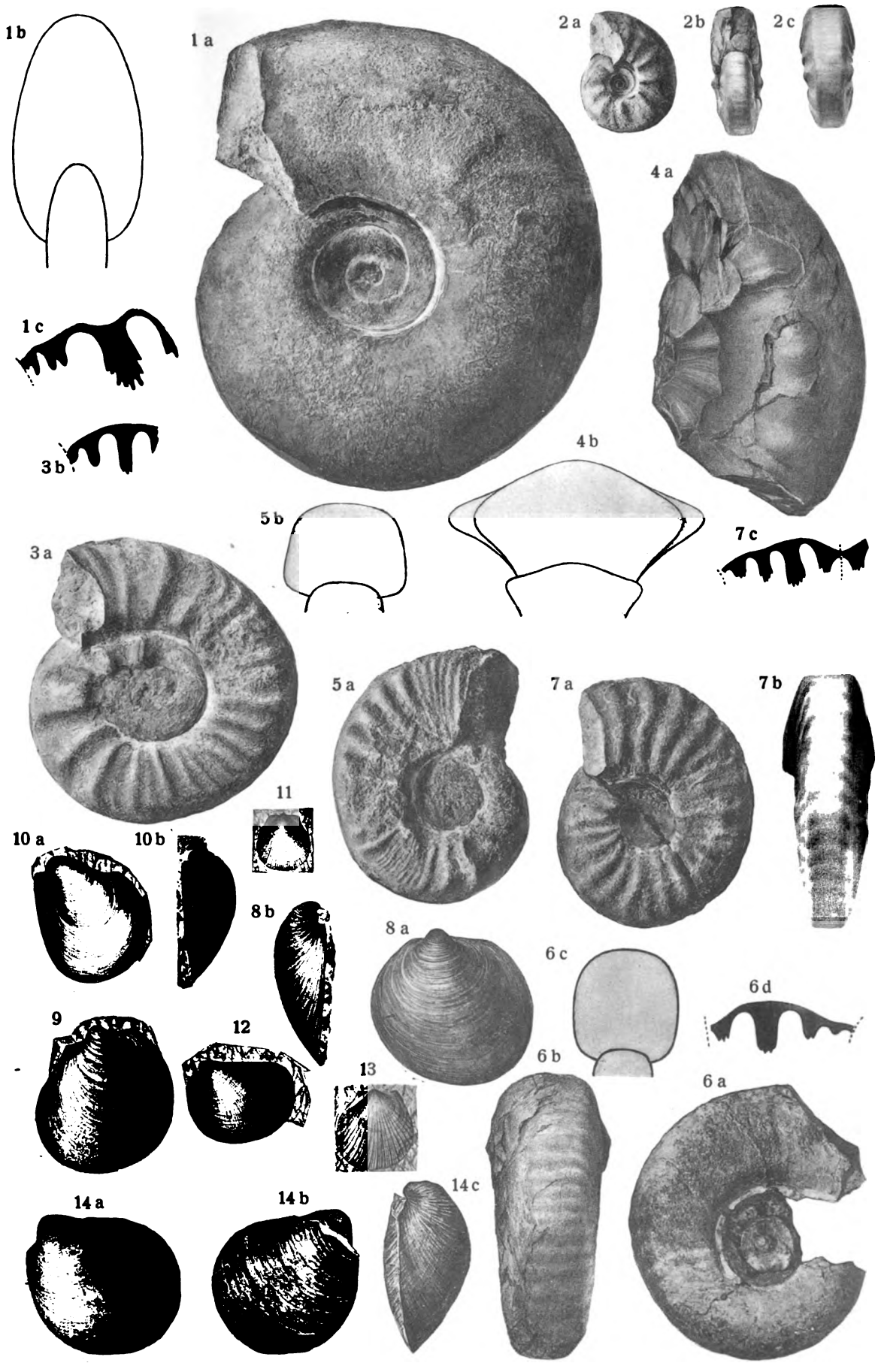

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PLATE VI.

Fig. 1 *a*, *b*, *c*. Ptychites Brückneri nov. sp. Lam, Patarkul valley.
„ 2 *a*, *b*, *c*. Proteites indicus nov. sp. Ridge N. 15° W. of Khrew.
„ 3. Thuringionautilus sp. ind. (transverse section). Pastannah.
„ 4 *a*, *b*. Grypoceras Vihianum nov. sp. Ridge N. 15° W. of Khrew.
„ 5 *a*, *b*. Grypoceras Vihianum nov. sp. Pastannah.
All specimens from the Muschelkalk.

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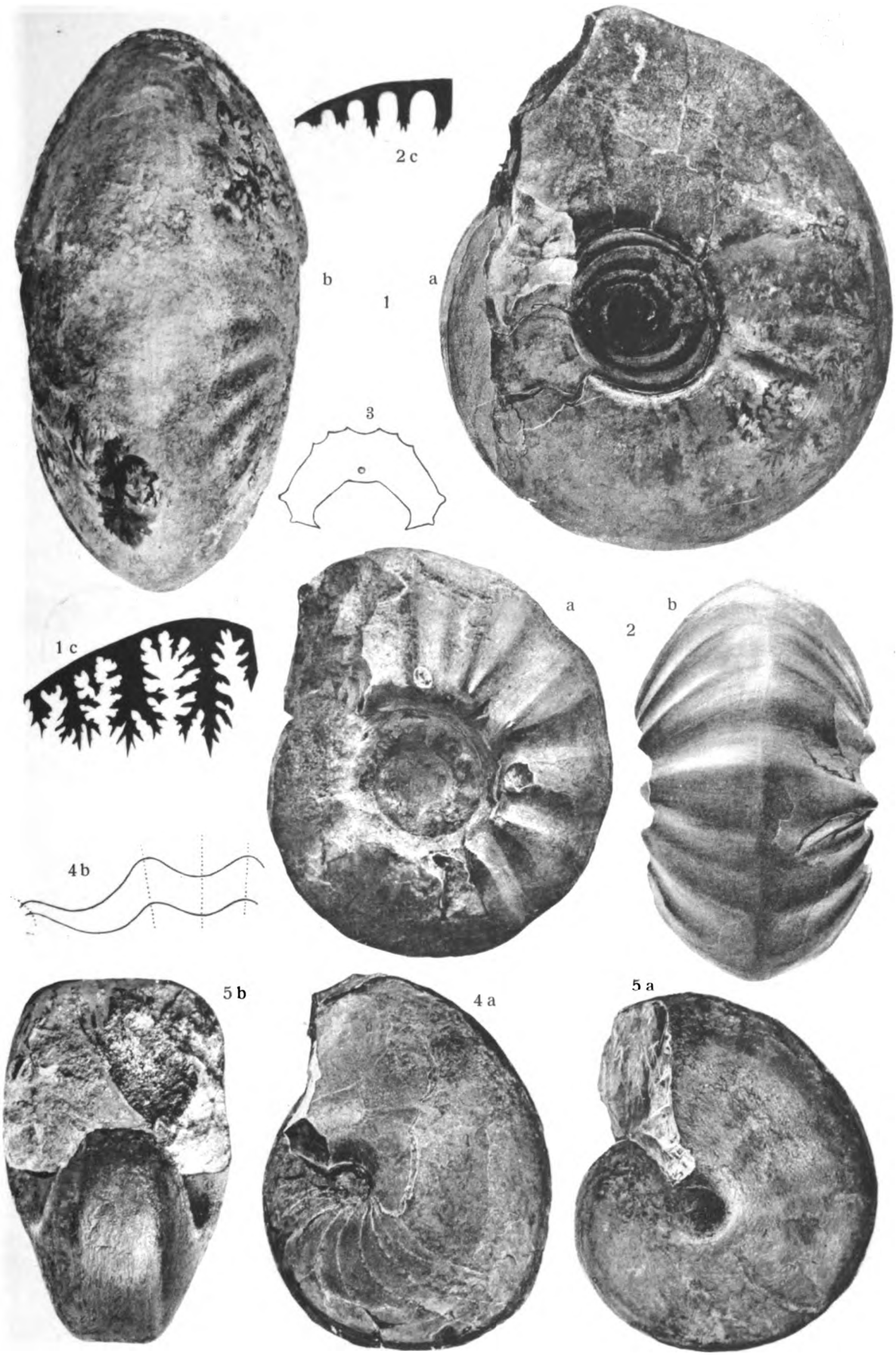

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PLATE VII.

Fig. 1 *a*, *b*. Ceratites sp. ind. aff. falcifero Hau. Temple hill, Khrew.
„ 2. Ceratites Thuilleri Opp. Spur N.N.E. of Khunmu.
„ 3 *a*, *b*. Ceratites Thuilleri Opp. Temple hill, Khrew.
„ 4. Ceratites Kuvera Dien. E. of Guryul ravine, Khunmu.
„ 5 *a*, *b*. Hungarites sp. ind. Pastannah.
„ 6 *a*, *b*. Hungarites sp. ind. Pastannah.
„ 7. Acrochordiceras cf. enode Hau. Ridge N. 15° W. of Khrew.
„ 8 *a*, *b*. Acrochordiceras cf. Haueri Arth. Lam, Patarkul valley.
„ 9 *a*, *b*. Smithoceras Herminæ Dien. Pastannah.
„ 10. Smithoceras Herminæ Dien. Temple hill, Khrew.

All specimens from the Muschelkalk.

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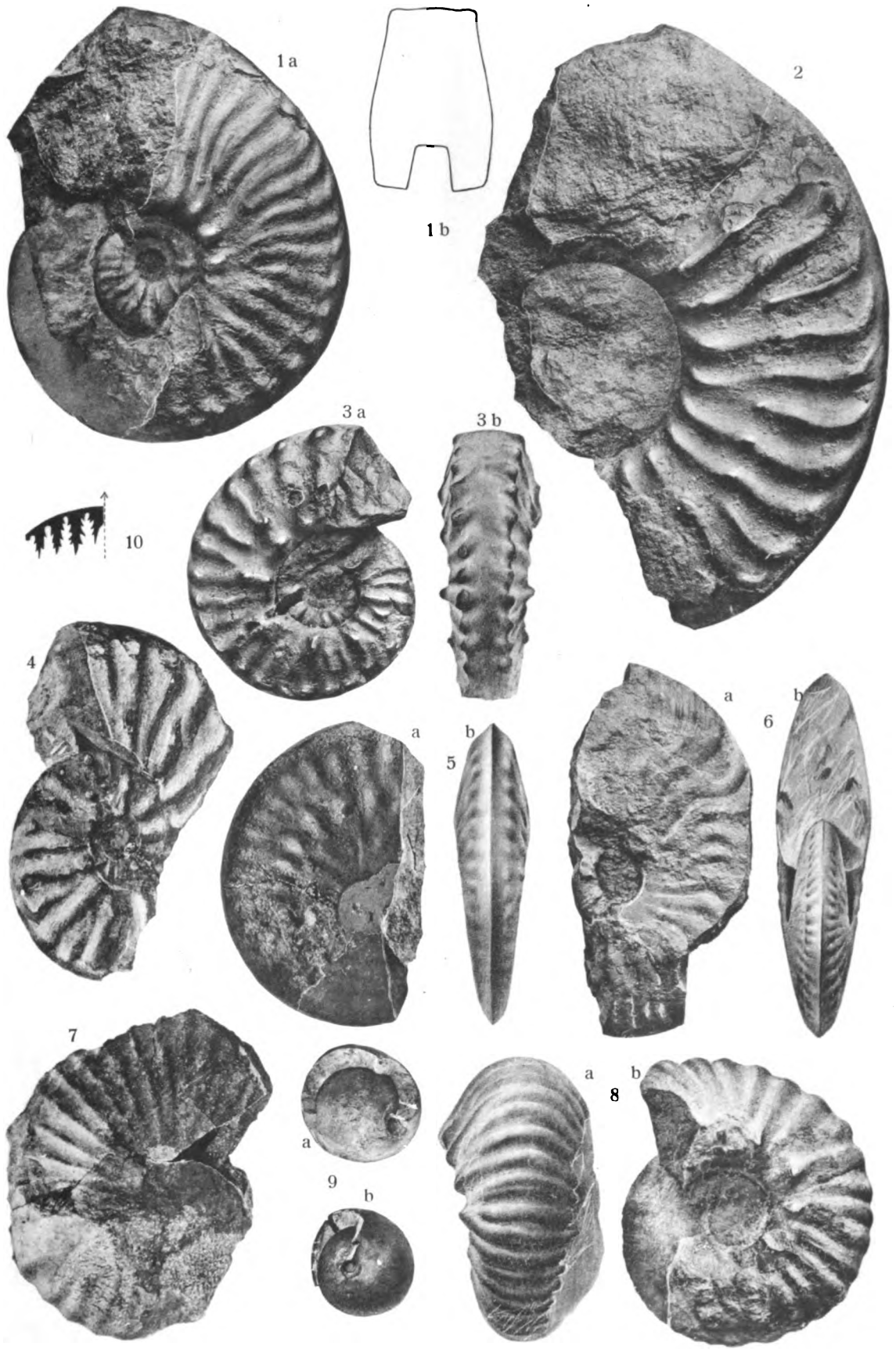

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PLATE VIII.

Fig. 1 *a, b.* Ceratites sp. ind. aff. superbo Mojs. E. of Guryul ravine.
„ 2 *a, b, c, d.* Ceratites onustus Opp. Temple hill, Khrew.
„ 3 *a, b.* Ceratites sp. ind. aff. Thuilleri Opp. Lam, Patarkul valley.
„ 4 *a, b.* Ceratites sp. ind. aff. binodoso Hau. Lam, Patarkul valley.
„ 5. Ceratites truncus Opp. Pastannah.
„ 6 *a, b, c.* Sibirites cf. Prahlada Dien. Pastannah.

All specimens from the Muschelkalk.

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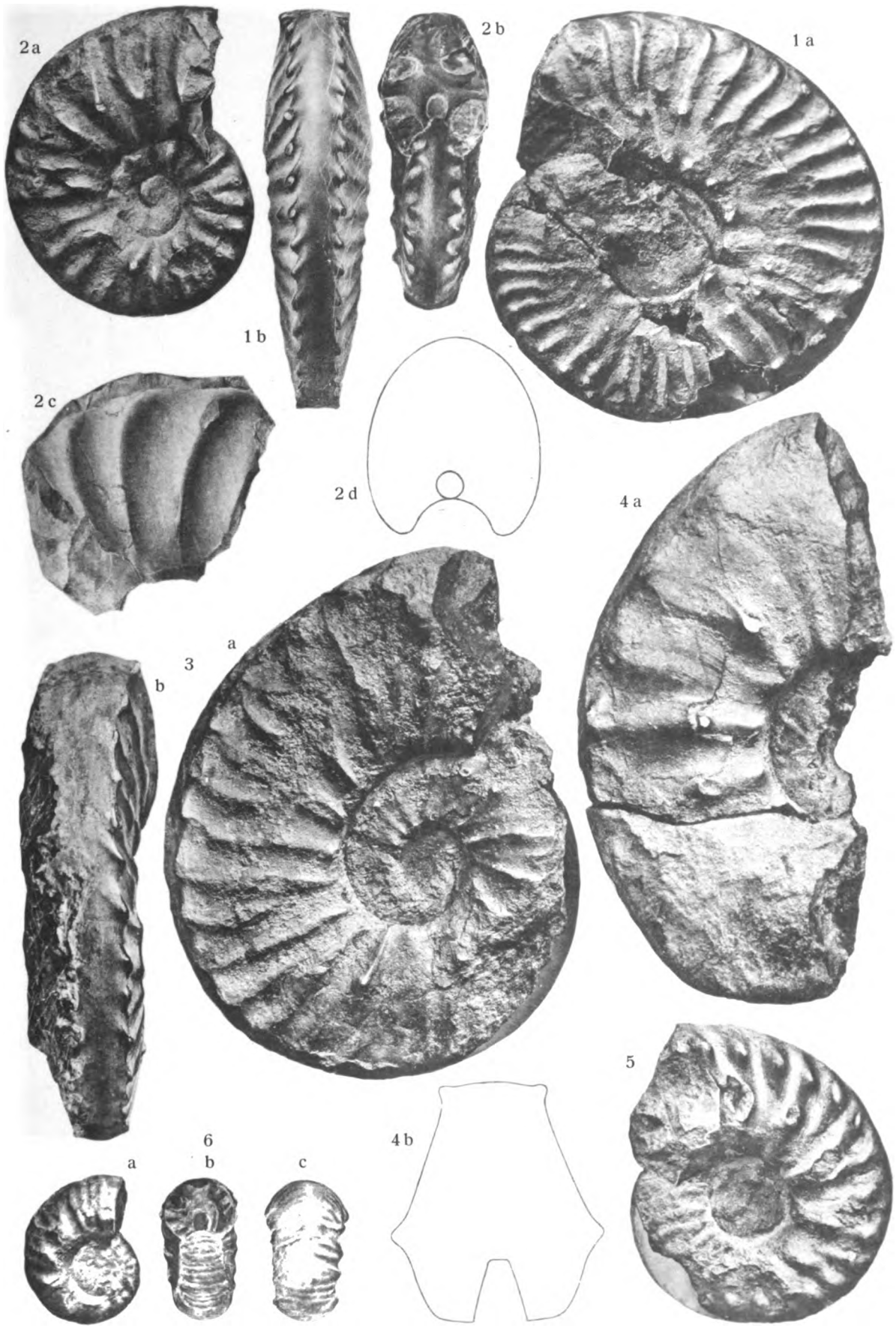

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PLATE IX.

Fig. 1 *a*, *b*. Ptychites Barclayi nov. sp. Spur N.N.E. of Khunmu.
„ 2. Ptychites Barclayi nov. sp. (Sutures.) E. of Guryul ravine, Khunmu.
„ 3 *a*, *b*. Smithoceras sp. ind. Pastannah.

All specimens from the Muschelkalk.

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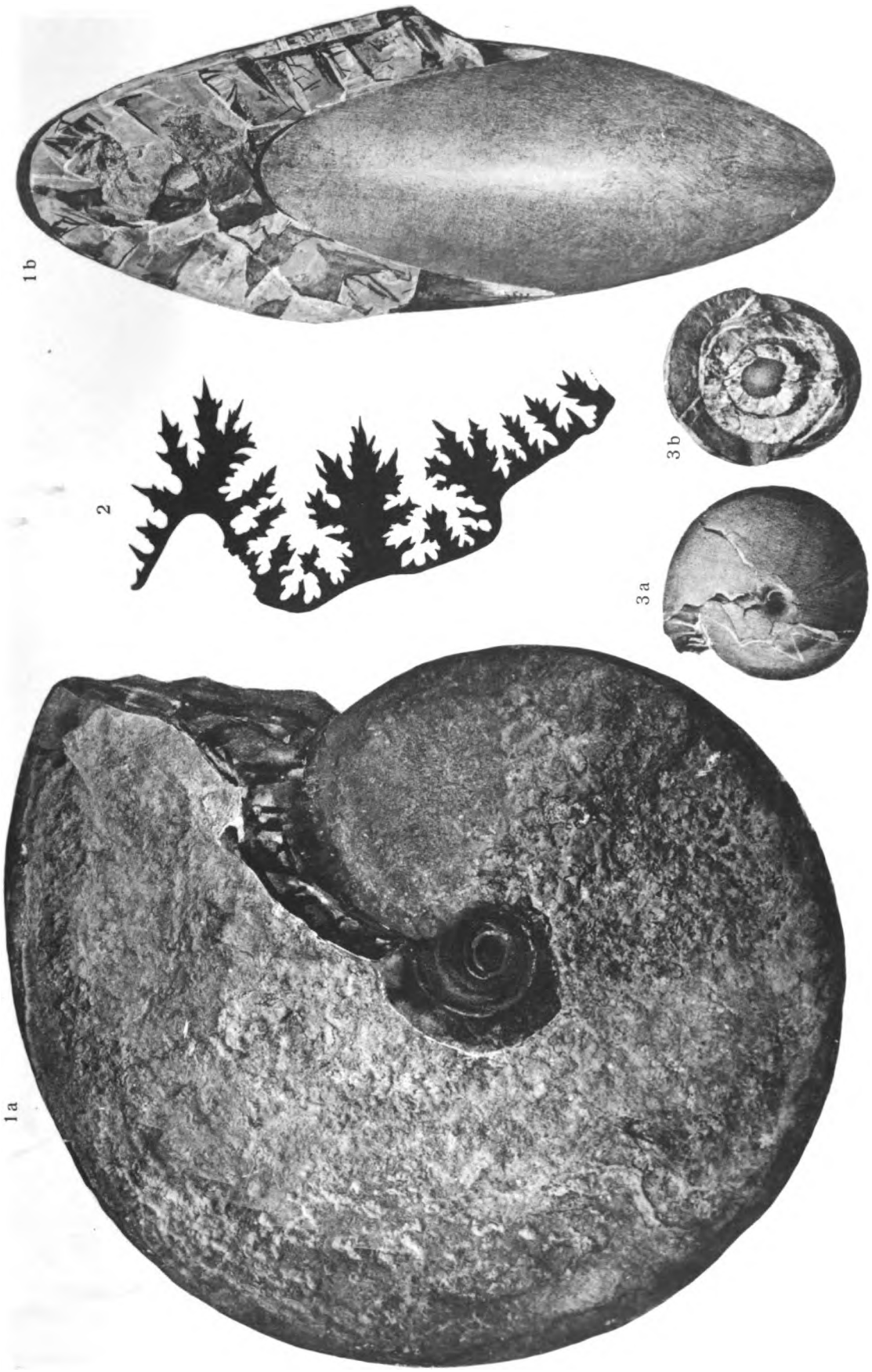

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PLATE X.

Fig. 1 *a, b, c.* Isculites Middlemissii nov. sp. Spur N.N.E. of Khunmu.
,, 2 *a, b.* Isculites sp. ind. (I). Pastannah.
,, 3 *a, b.* Isculites sp. ind. (II). Pastannah.
,, 4 *a, b, c.* Ptychites Cunninghami nov. sp. Spur N.N.E. of Khunmu.
All specimens from the Muschelkalk.

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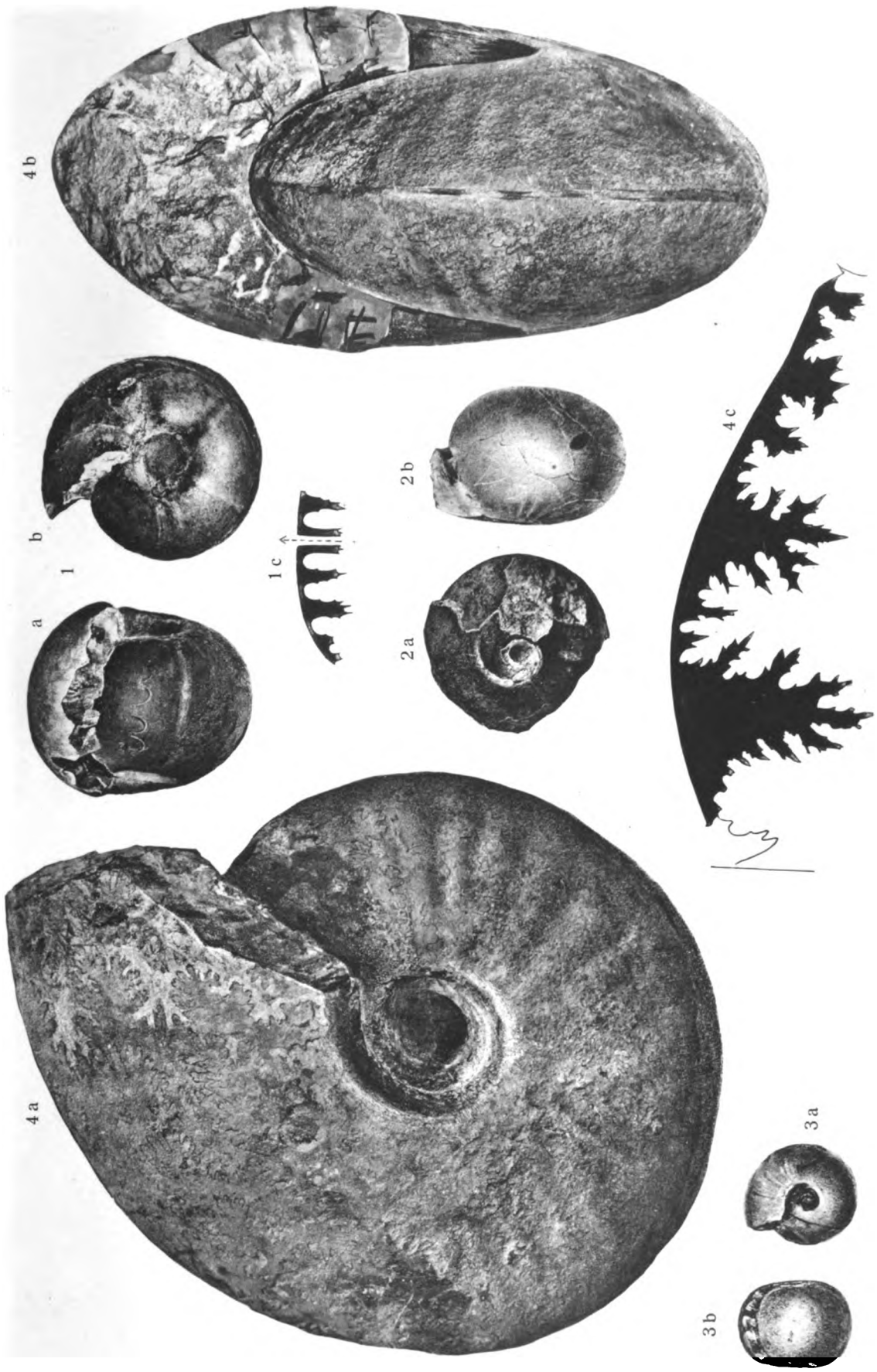

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PLATE XI.

Fig. 1 *a. b. c.* Paranautilus Kashmiricus nov. sp. Temple hill, Khrew.
„ 2. Conularia (?) sp. ind. E. of Guryul ravine.
„ 3 *a, b.* Euomphalus sp. ind. Pastannah.
„ 4 *a, b.* Marmolatella sp. ind. Pastannah.
„ 5 *a, b.* Scurria sp. ind. E. of Guryul ravine.
„ 6 *a, b.* Myophoria sp. ind. aff. lævigatæ Ziet. E. of Guryul ravine.
„ 7. Myophoria sp. ind. Gap on ridge N. 15° W. of Khrew.
„ 8 *a, b.* Mysidioptera eximia nov. sp. 1 mile W. of Pastannah.

All specimens from the Muschelkalk.

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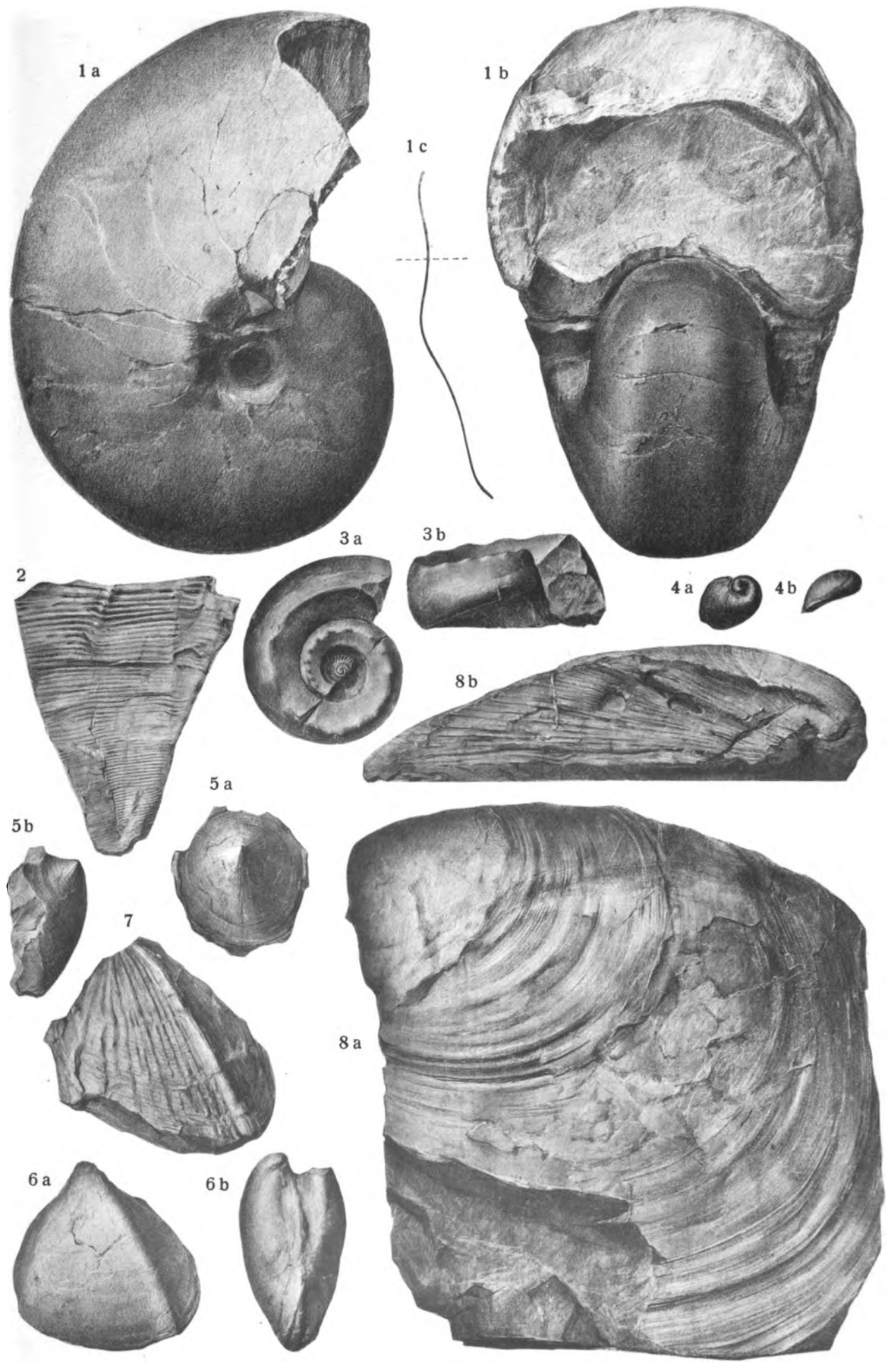

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PLATE XII.

Fig. 1. Pleurophorus sp. ind. E. of Guryul ravine.
„ 2. Pleurophorus an Heminajas sp. ind. E. of Guryul ravine.
„ 3. Modiola sp. ind. Pastannah.
„ 4 *a*, *b*. Arcoptera indica nov. sp. E. of Guryul ravine.
„ 5. Perna sp. ind. aff. vetustæ Goldf. Pastannah.
„ 6 *a*, *b*. Avicula Pastannahensis nov. sp. Pastannah.
„ 7 *a*, *b*, *c*. Anodontophora Patarkulensis nov. sp. Lam.
„ 8. Anodontophora sp. ind. N. 15° W. of Khrew.
„ 9.
„ 10 *a*, *b*. } Lima sp. ind. aff. subpunctatæ D'Orb. N. 15° W. of Khrew.
„ 11 *a*, *b*.
„ 12. Lima sp. ind. (striatæ). Pastannah.
„ 13. Mysidioptera sp. ind. Pastannah.
„ 14. Pecten sp. ind. N. 15° W. of Khrew.
„ 15. Anomia triadica nov. sp. Lam.
„ 16. Anomia triadica nov. sp. N. 15° W. of Khrew.
„ 17 *a*, *b*. Trigonodus an Pachycardia sp. ind. N. 15° W. of Khrew.
„ 18 *a*, *b*. Lithophagus sp. ind. Pastannah.
„ 19 *a*, *b*, *c*, *d*. Spiriferina Stracheyi Salt. N. 15° W. of Khrew.
„ 20 *a*, *b*, *c*, *d*. } Rhynchonella trinodosi Bittn. N. 15° W. of Khrew.
„ 21 *a*, *b*, *c*.
„ 22.

All specimens from the Muschelkalk.

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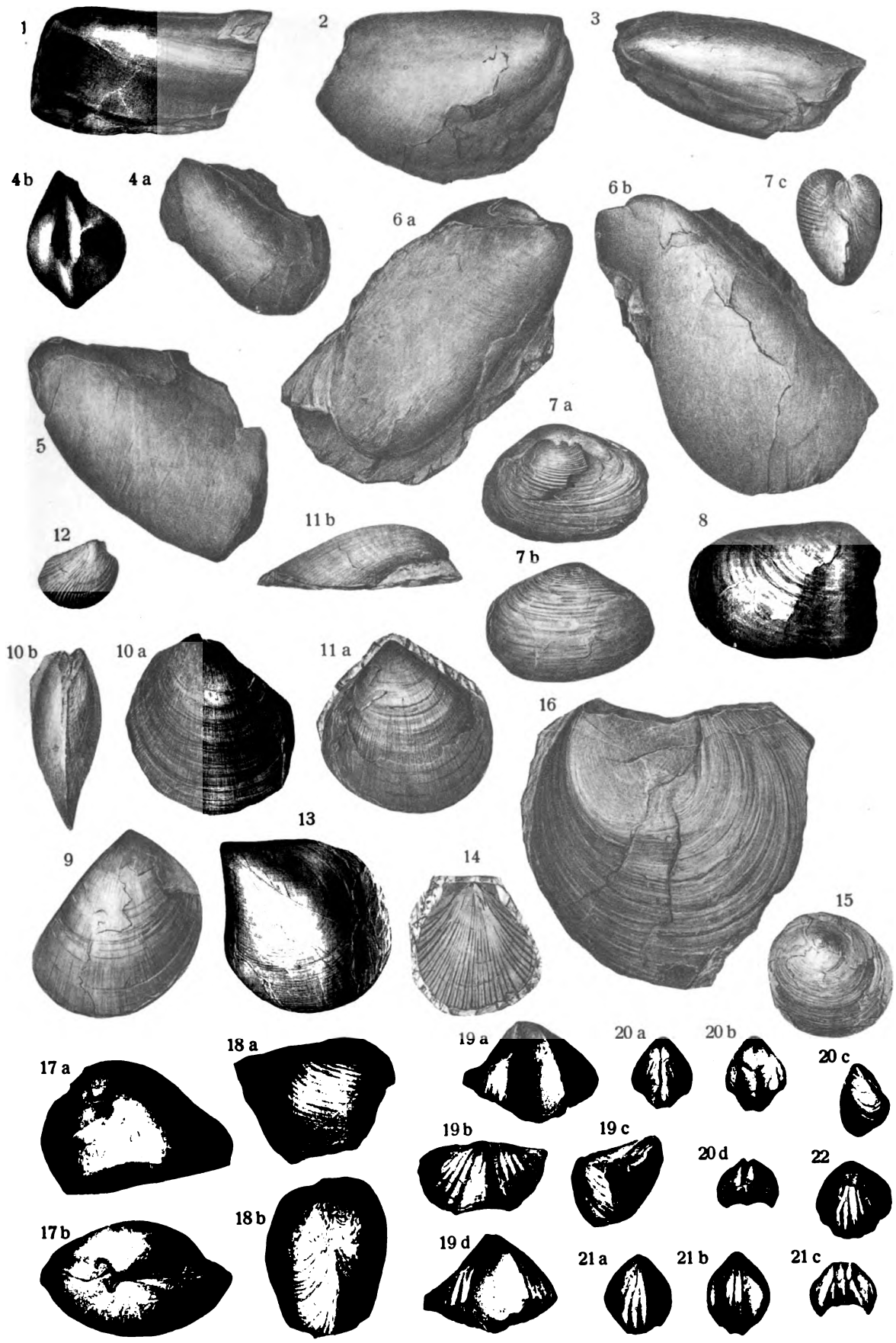

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PLATE XIII.

Fig. 1 *a, b, c. d.* Rhynchonella Lamana nov. sp. Lam.
„ 2 *a, b, c, d.* Rhynchonella Lamana nov. sp. Pastannah.
„ 3 *a, b, c, d.* Rhynchonella Lamana nov. sp. Lam.
„ 4 *a, b, c, d.* Rhynchonella Lamana nov. sp. Pastannah.
These four specimens from the Muschelkalk.

„ 5.
„ 6.
„ 7. } Myophoria cf. Kefersteinii Muenst. var. multiradiata Waag. Pastannah.
„ 8.
„ 9.

„ 10.
„ 11. } Myophoria Middlemissii nov. sp. Pastannah.
„ 12.

„ 13. Myophoria sp. ind. aff. Whateleyæ Buch. Pastannah.
„ 14. Myophoria sp. ind. aff. Whateleyæ Buch. Pastannah.
„ 15 *a, b, c.* Hœrnesia Bhavani nov. sp. Pastannah.
„ 16 *a, b.* Hœrnesia Bhavani nov. sp. Pastannah.
„ 17. Hœrnesia Bhavani nov. sp. Spur N.W. of Khrew.
„ 18. Trigonodus sp. ind. Pastannah.
„ 19. Lima cf. subpunctata D'Orb. Pastannah.
„ 20. Pecten (Chlamys) Middlemissii nov. sp. Pastannah.
„ 21. Pleurophorus cf. Curionii Hau. Lam.
„ 22. Spiriferina Stracheyi Salt. Lam.
„ 23 *a, b, c, d, e.* Spiriferina Stracheyi Salt. Lam.
„ 24 *a, b.* Spiriferina Stracheyi Salt. Spur N.W. of Khrew.
„ 25 *a, b, c, d.* Spiriferina sp. ind. aff. Lilangensis Stol. Spur N.W. of Khrew.
„ 26 *a, b, c, d.* Rhynchonella trinodosi var. Freshfieldi Dien. Spur N.W. of Khrew.
„ 27 *a, b, c, d.* Dielasma julicum Bittn. Pastannah.
All specimens from the Upper Trias

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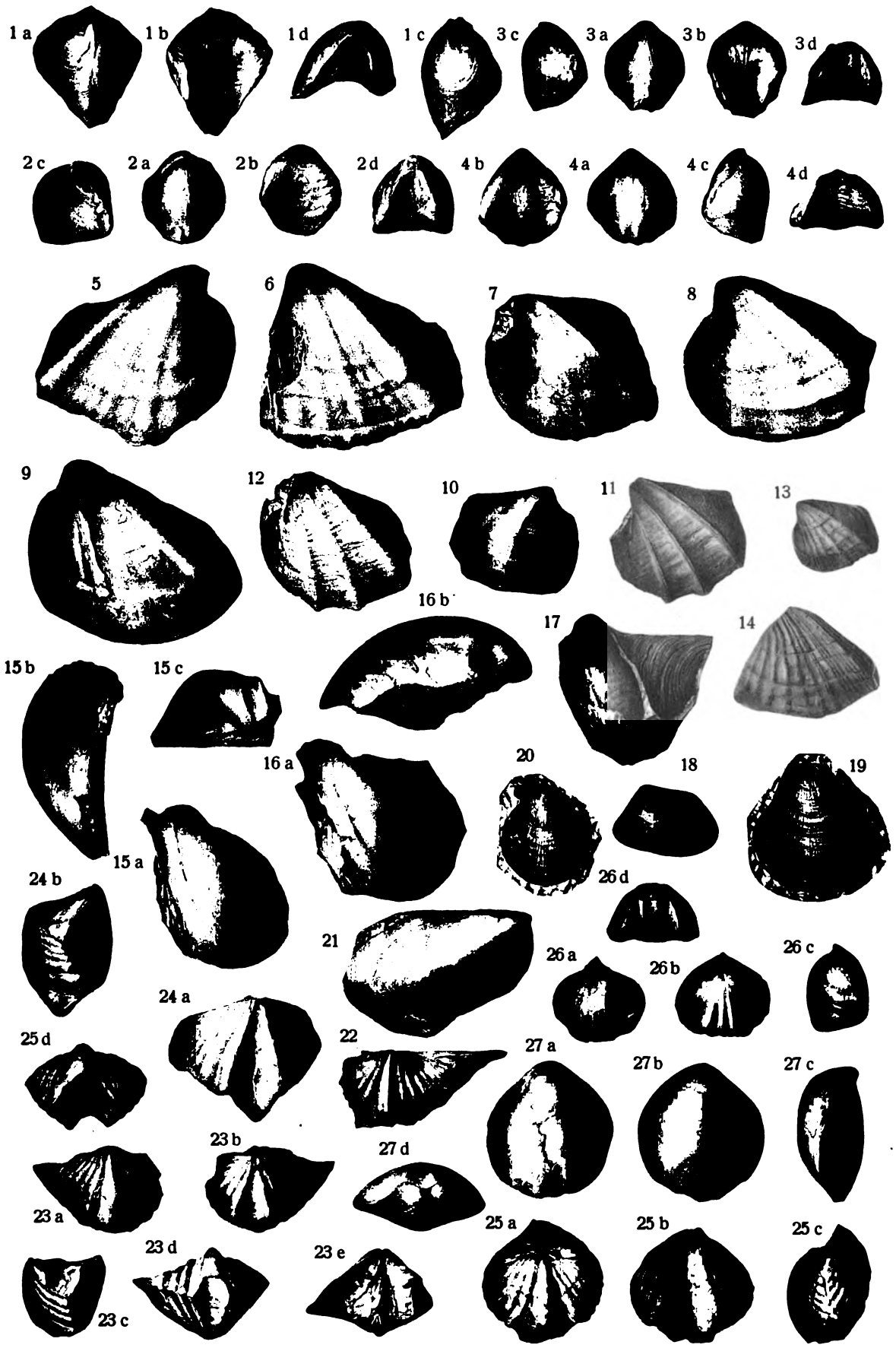

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